DELMARVA RIVER BASINS SURVEY

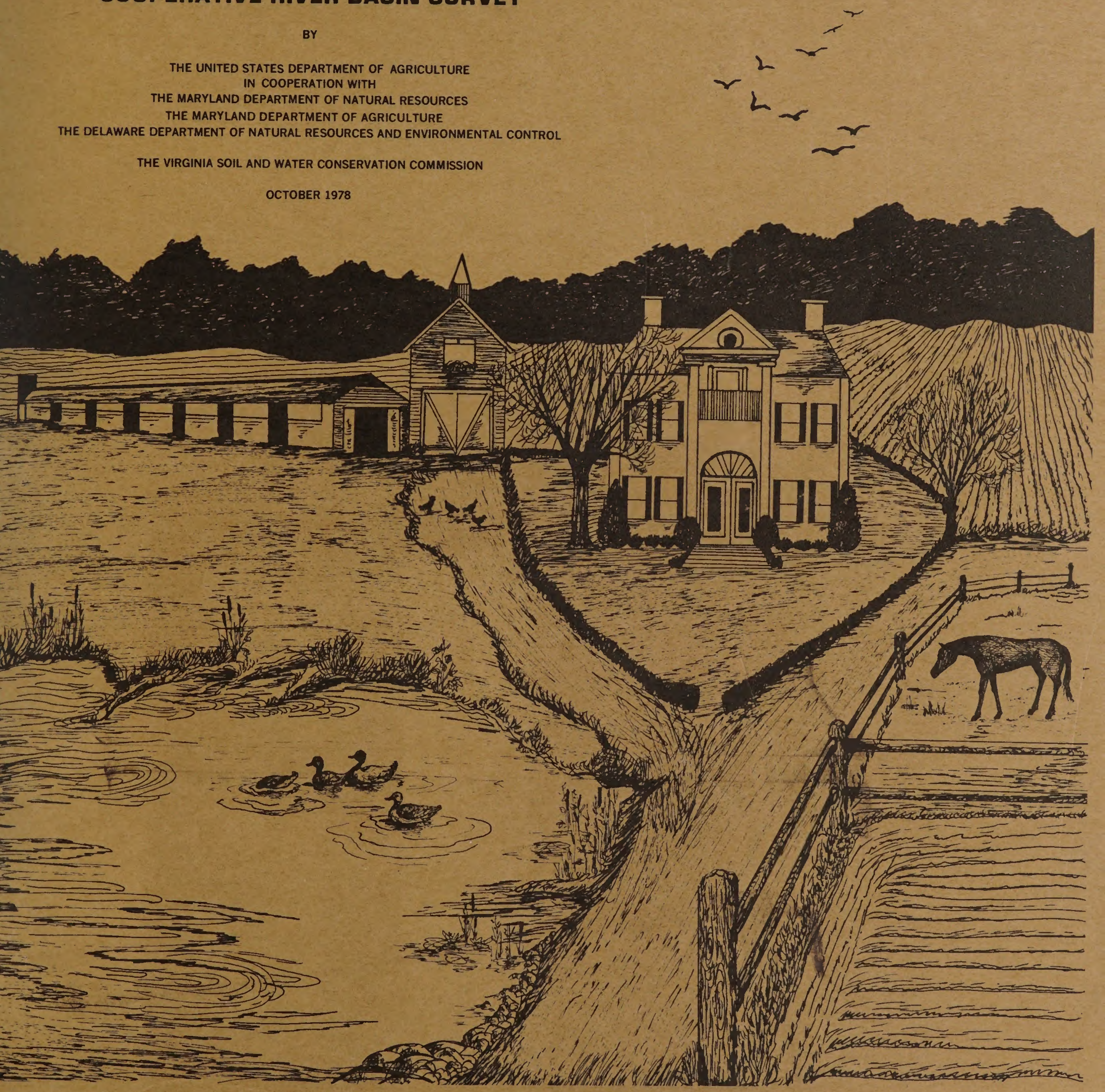
COOPERATIVE RIVER BASIN SURVEY

BY

THE UNITED STATES DEPARTMENT OF AGRICULTURE
IN COOPERATION WITH
THE MARYLAND DEPARTMENT OF NATURAL RESOURCES
THE MARYLAND DEPARTMENT OF AGRICULTURE
THE DELAWARE DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENTAL CONTROL

THE VIRGINIA SOIL AND WATER CONSERVATION COMMISSION

OCTOBER 1978



Cover: Characteristic of the Delmarva Peninsula's rural areas, cropland and pastureland, poultry houses, well-kept farm houses, woodland, domestic animals and wildlife offer a tranquil, peaceful setting. This scene was drawn by C. Dwayne Jones, Soil Conservation Associate for Wicomico County Soil Conservation District.

MAIN REPORT

DELMARVA RIVER BASINS
COOPERATIVE SURVEY

WATER AND LAND RESOURCES

Prepared by

UNITED STATES DEPARTMENT OF AGRICULTURE
ECONOMICS, STATISTICS, AND COOPERATIVES SERVICE
US FOREST SERVICE
US SOIL CONSERVATION SERVICE

in cooperation with
the States of
MARYLAND, DELAWARE, VIRGINIA

OCTOBER 1978

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SUMMARY

Purpose

The purpose of this study is to evaluate the water and related land resources of the Delmarva River Basins, identify problems associated with their use and development, determine present and future needs for resource development, and propose alternatives for the orderly development of these resources.

Problems

A problem of competing land resource use exists among urban, agricultural, environmental, industrial, and recreational interests. Changing land use without careful planning has caused a degrading of the environment and exploitation of water and related land resources in many areas.

Inadequate surface and subsurface drainage of agricultural crop and pasture land is a severe problem due to seasonally high water tables and the lack of adequate outlets for on-farm drainage systems. This lack of outlets hinders installation of related land treatment and water management measures.

Sheet and rill erosion account for the majority of total erosion, although channel and gully erosion are critical at some sites.

Flooding along channels and inundation of large areas by surface water causes damages to crops, homes, roads and bridges, commercial establishments, and other facilities.

Crops on some soils need irrigation for adequate water supply in dry periods.

The primary problem associated with forest land on the Peninsula is the decline in timber quality caused by poor management on private forest land. Poor management and logging practices have left many timber stands poorly stocked and with trees of low economic value.

Objectives

The problems summarized in the previous section have been translated into component objectives to identify the type and quantity of

7. Provide land leveling for 31,380 cropland acres

8. Improve pastureland management on 72,180 acres

9. Construct 550 farm ponds

10. Plant (open field) 8,230 acres to create forest land

11. Reinforce or convert 16,300 acres of forest land

12. Provide improvement on 193,600 acres of forest land

13. Install 950 miles of outlet channels

14. Provide on-farm drainage for 62,290 acres of cropland and pastureland

15. Treat 8,800 acres of road areas, gullies and borrow pits for erosion control and esthetics

16. Treat 5,845 acres of construction acres each year for erosion and sediment control

17. Provide 5,400 artificial home structures for wood ducks and fox squirrels

18. Establish and maintain 180 miles of roadside shrub borders for wildlife habitat

19. Establish 740 acres of aquatic vegetation

20. Provide 840 acre feet of fish habitat through sediment traps and channel outlets

21. Improve wildlife management on 57,600 acres of forest land through thinning and fire measures

22. Improve wildlife management by planting food and cover plants on 6,200 acres of odd shaped areas

23. Install 800 cropland water control structures for waterfowl

24. Preserve scenic rivers as designated

25. Improve and establish hedgerows on 2,780 acres to create wildlife habitat

26. Create 7,710 acres of ditchbank herbaceous habitat with on-farm drainage

27. Provide 560 acres of shrub edge release [1]

28. Manage 13,560 acres for fish pond habitat

29. Provide three miles of livestock exclusion fencing around ponds

30. Establish 850 miles of shoreline buffer strips

31. Provide display map showing site identification for threatened and endangered species and wetlands

USDA Program Opportunities

The programs or actions that could be used by the U.S. Department of Agriculture (USDA) to implement the suggested alternative are discussed in Chapter VII of this report.

The Soil Conservation Service (SCS) administers several programs authorized by various federal laws. The Small Watershed Act, PL 83-566 enables SCS to provide assistance in group action programs for drainage and flood prevention projects. Through Public Law 46 assistance can be given for planning and installing land treatment measures. The Food and Agriculture Act, PL 87-703, authorized the organization of Resource Conservation and Development (RC&D areas). Assistance is especially geared for the conservation improvement, development and use of natural resources for the entire community.

The Forest Service administers several programs to intensify and improve forest management and increase forestry production. The Forest Service and Agricultural Stabilization and Conservation Service (ASCS) jointly administer the Forest Incentives Program (FIP). The Wild and

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1 Shrub edge release - a selective removal of tree species adjacent to the field edge to eliminate elements of competition thus allowing diversification through development of the shrub species.

Scenic Rivers Act, PL 90-542, provides for the preservation of certain selected rivers. The Forest Service, USDA, and the Heritage Conservation and Recreation Service of USDI administer this act. In addition to the cooperative programs adminstered by the USDA, the states also have programs to protect and enhance land and water conservation. Among these are the various seed-tree laws which are designed to insure reproduction of trees in cutover and harvest areas.

Various supporting activities are provided by the ASCS, Farmers Home Administration (FmHA), and Economics, Statistics, and Cooperatives Service (ESCS).

Recommendations

To implement some of the plan elements, especially those that have environmental quality aspects, new programs must be initiated. Expansion of other programs such as the RC&D program should aid in the implementation of both the NED and EQ elements. Chapters VII and VIII discuss those areas where additional research and programs are needed. Some of these programs are:

1. The Maryland Eastern Shore RC&D area needs to be approved for operation to provide funding for implementation of more EQ elements.

2. Wider implementation of existing federal forestry programs are needed to increase management activities.

3. Wider implementation of total environmental planning needs to be included in all water and land resource programs.

4. Research is needed in the effects of vegetative practices to enhance environmental values as well as prolong the life of structural measures.

5. More recognition of secondary recreational and wildlife values in conservation planning activities.

Use That Can Be Made of the Study

The study was made so that various programs of the United States Department of Agriculture can be effectively coordinated with programs of state, local and other federal agencies. It will serve as a guide in coordinating water and related land resource development programs and projects. The information presented in this report and other basic data will enable planners from all levels to coordinate their planning efforts and avoid unnecessary conflicts.

The study was closely coordinated with the Chesapeake Bay Study [2] and its objectives to prevent any duplication of effort between the two studies. This study can be used in connection with the Chesapeake Bay Phase III Study.

The basic data collected and used in this study are on file at the Soil Conservation Service, 4321 Hartwick Road, Room 522, College Park, Maryland 20740; Economics, Statistics, and Cooperatives Service, 1974 Sproul Road, Fourth Floor, Broomall, Pennsylvania 19008; and U.S. Forest Service, 180 Canfield Street, Morgantown, West Virginia 26505.

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2 The Chesapeake Bay Study is currently being conducted by the U.S. Army Corps of Engineers. The Corps published the Existing Conditions Report, the Future Conditions Report, and is finalizing the plan of study for Phase III. This phase will study solutions to high priority problems and will formulate and make recommendations based on testing conducted on the Chesapeake Bay Hydraulic Model.

CHAPTER I - INTRODUCTION

Purpose of Study

The purpose of this study is to evaluate the water and related land resources of the Delmarva River Basins; identify problems associated with their use and development; determine present and future needs for resource development; and propose alternatives for the orderly development of these resources. The overall intent of the study is to improve the quality of life through contributions to the objectives of national economic development (NED) and environmental quality (EQ). The NED objective is to increase the value of the nation's output of goods and services and improve national economic efficiency. The EQ objective is to manage, conserve, preserve, create, restore, and improve the quality of natural and cultural resources and ecological systems.

Authority for Study

The States of Maryland, Delaware, and Virginia requested the United States Department of Agriculture to participate in a cooperative river basin survey of the Delmarva River Basins. Participation in the cooperative river basins survey by the United States Department of Agriculture was under authority of Section 6 of Public Law 83-566 as amended and supplemented. The principal participants within the Department of Agriculture included the Soil Conservation Service, the Economics, Statistics, and Cooperatives Service, and the Forest Service. The Maryland Department of Natural Resources, the Maryland Department of Agriculture, the Delaware Department of Natural Resources and Environmental Control, and the Virginia Soil and Water Conservation Commission coordinated and provided leadership for the survey in their respective states. Other state and local government agencies and regional planning commissions and councils made major contributions to the survey.

Nature of Study

This is a cooperative river basins survey. It discusses the availability of the water and related land resources to meet the present and future needs of the basins and presents a suggested alternative for achieving orderly and beneficial utilization, development and conservation of these resources. Specific evaluations were made for flooding, land treatment, soil erosion and sedimentation, drainage, irrigation, water supply and water quality, and fish and wildlife.

Description of the Study Area

The Delmarva River Basins Survey area includes all of the Maryland Eastern Shore below the Chesapeake and Delaware Canal, the State of Delaware below the Canal, and the Virginia Eastern Shore. This includes the Maryland Counties of Worcester, Somerset, Wicomicc, Dorchester, Talbot, Caroline, Queen Annes, Kent and part of Cecil; Sussex Kent and part of New Castle Counties in Delaware; and Accomack and Northampton Counties in Virginia. Thirty percent of the survey area is in Delaware, 12 percent is in Virginia, and 58 percent is in Maryland. A map of the study area is displayed in Figure II-1.

The word "Delmarva" is a contraction of the names of the three states - Delaware, Maryland, and Virginia -- that share jurisdiction over the Peninsula. The Delmarva Peninsula is unique in two respects. First, it is the only peninsula in the United States divided among three states. Second, the official state boundaries within the peninsula are artificial, as opposed to being natural barriers — such as mountains, rivers, or other bodies of water. The reason for the unique political subdivision of the area can only be explained by reviewing the history of the Delmarva Peninsula.— frequent site of territorial disputes between sovereign states seeking control over the vast and varied resources of the area.

The area covers 7,500 square miles, is about 174 miles long, 74 miles wide at the widest point, and includes approximately 3,558,000 acres of land and 1,282,000 acres of water. It is characterized by low topographic relief typical of the Atlantic Coastal Plain. Elevations range from sea level to about 150 feet.

Approximately 41 percent of the land area is cropland; 38 percent forest; 1 percent pasture; 13 percent miscellanecus or idle; and 7 percent urban and built-up, federally owned, and small water areas.

The climate is humid with an average annual rainfall of 43 inches. The mean annual temperature on the Peninsula is approximately 56 degrees Farenheit.

The Delmarva River Basins lie entirely within the Atlantic Coastal Plain physiographic province. Underlying the Coastal Plain are clays, silts, sands, and gravels, with some shell beds. These sediments were deposited mostly in a marine, off-shore environment, although some are of fluvio-deltaic origin. The total thickness of the sediments is 6,000 feet or more, overlaying a basement of crystalline rocks that actually are a continuation of the Piedmont, sloping seaward beneath the Coastal Plain at less than 80 feet per mile.

Deposits range in age from Cretaceous (60 million years old) to recent. In order from oldest to youngest, the Coastal Plains formations are as follows:

1. The Patuxent Formation - Cretaceous

2. The Patapsco Formation - Cretaceous

3. The Nanjemoy Formation - Tertiary

4. The Calvert Formation - Tertiary

5. The Yorktown Formation - Tertiary

6. The Columbia group of Pleistocene - Quaternary

7. Recent - Quaternary

The principal cities in the area are Chestertown, Denton, Pocomoke City, Easton, Cambridge, Salisbury, and Ocean City, Maryland; Dover, Georgetown and Milford, Delaware; Exmore and Cape Charles, Virginia.

Population growth and economic development are significant factors in the supply and demand of water and related land resources. The Peninsula's rapid growth will place additional demands upon all natural resources and added care should be taken in planning the future use of these resources.

The population of the Peninsula grew approximately 46.6 percent between 1950 and 1970 and an additional 6.7 percent between 1970 and 1976.

Agriculture is the major economic force and employer within the Peninsula, supporting an agri-business complex that includes hatcheries, feed mills, and processing plants of integrated broiler firms; vegetable canning and freezing plants, and suppliers of machinery, fertilizer, and other farm inputs.

Although employment in forest industry is considerable below the peak employment years of the late 1950's and early 1960's forest resources, timber, recreation, and wildlife habitat are still important to the economy of the area. There are plywood and chip mills as well as sawmills and wood treating plants located on the Peninsula.

Employment on Delmarva cannot by typified for the whole region. There are different primary employers and industries in various areas of the Peninsula. These different industries have varying employment needs, with some having stable work forces, and others having a work force which is fluctuating. The cyclical employment is reflected in a lower per capita income in some areas.

Basins Problems

A problem of competing land resource use exists between urban, agricultural, environmental, industrial, and recreational interests. Changing land use without careful planning has caused some environmental degradation and exploitation of water and related land resources in many areas.

Inadequate surface and subsurface drainage of cropland, pastureland, and urban areas is a severe problem due to seasonally high water tables and the lack of adequate outlets for drainage systems. The lack of outlets hinders installation of related land treatment and water control measures.

Sheet and rill erosion account for the majority of total erosion, although channel and gully erosion are critical at some sites.

Flooding along channels and inundation of large areas by surface water damage crops, homes, roads and bridges, commercial establishments, and other facilities.

The primary problem associated with forest land on the Peninsula is the decline in timber quality caused by poor management on private forest land. Poor management and logging practices have left many stands poorly stocked and with trees of low economic value.

Objectives and Needs

The problems summarized in the previous section have been related to component objectives to identify the type and quantity of desired effects. These component objectives were directed toward improvement in the quality of life through contributions to the objectives of national economic development (NED) and environmental quality (EQ).

Specific objectives of the study were:

National Economic Development

1. Improve water and related land resource management

   a. Reduce flood damages

b. Reduce erosion and sediment damages

c. Reduce drainage problems

2. Improve municipal, industrial, domestic, and irrigation water supply

    a. Provide adequate water supply to communities to meet projected needs where existing sources will be inadequate

    b. Provide adequate water supply for projected irrigation needs

3. Enhance and increase recreational opportunities

    a. Provide recreational opportunities to help meet the projected needs

Environmental Quality

1. Maintain and enhance fish and wildlife habitat

2. Improve water quality

USDA Agency Responsibilities

USDA agency participation was carried out in accordance with assigned responsibilities and coordinated through the Washington Advisory Committee and the Field Advisory Committee. The three USDA agencies functioned as a planning team under the guidance of the Field Advisory Committee. Each agency had leadership responsibilities for designated aspects of the survey. The overall responsibility for each agency was as follows:

Soil Conservation Service

The Soil Conservation Service had overall responsibility for the survey and specific responsibility for the following:

1. Providing the chairman for the Field Advisory Committee

2. Making physical appraisals of agricultural

and rural water problems and resource development needs and defining them

3. Determining the development potentials of upstream areas, including the physical and economic feasibility of watershed projects

4. Evaluating the physical and economic effects of upstream projects and coordinating them with the proposals of other departments

5. Determining treatment needs for non-federal open lands in the basin

Forest Service

The Forest Service had responsibility for the following:

1. Determining present and future cover conditions and treatment needs of all forest lands.

2. Analyzing the forest resource sector of the economy

3. Making investigations and analyzing pertinent to use, treatment, development and management of forest lands to meet basin-wide needs for water and related land resource development

4. Appraising the water needs of forest lands and forest-based industries

5. Determining impacts of proposals by other agencies on forest lands

Economics, Statistics, and Cooperatives Service

Economics, Statistics, and Cooperatives Service had responsibility for the following:

1. Making the economic base survey

    a. Analysis and projection of (a) economic activity in the agricultural and related sectors of the economy, (b) other economic activity in rural areas, and (c) the demand for land and water resource in such activities

b. Assessment of the current and projected demands for goods and services obtainable from the use of water and related land resources and the translation of such demands into economic needs for development

2. Making studies of problems and needs

   a. Analysis of agricultural and rural water problems as they relate to economic activity in rural areas, specifically to the volume and value of production, employment, and income

   b. Economic appraisal of agricultural and rural needs for water and related land resource development

3. Making impact studies and determining secondary effects

   a. Appraisal of prospective economic impact of development alternatives defined by the survey on the agricultural, rural, and related sectors of the economy and the economic relationship of these alternatives to the coordinated and comprehensive development of the basins

4. Providing consultative services

   a. Provide consultation to the Soil Conservation Service and the Forest Service in developing and applying standards and procedures for assessing the economic feasibility of watershed developments

Sponsoring and Cooperating Agencies

Close coordination between various state, local, and federal agencies was required to properly appraise water and related land resources of the Delmarva Peninsula.

Many federal, state, and local organizations have contributed to the survey by providing counsel and information and by participating in public meetings. Their cooperation and assistance is acknowledged. Significant contributions were made by the following:

Local

Counties
Municipalities
Soil and Water Conservation Districts

Private

Delaware Association of Conservation Districts
Maryland Association of Conservation Districts
National Wildlife Federation
Environmental Trust
Maryland Wildlife Society
Maryland Foresters Society
Local Representatives of Forest Industry
College of William and Mary (Biology De-
Department)
Maryland Watermen's Association

States

State of Maryland
- Department of Health and Mental Hygiene
- Department of Natural Resources
  - Fisheries Administration
  - Forest Service
  - Park Service
  - Wildlife Administration
  - Energy and Coastal Zone Administration
  - Water Resources Administration
  - Capital Programs Administration
- Department of State Planning
- University of Maryland
  - Cooperative Extension Service
- Transportation Department
- Department of Agriculture

State of Delaware
- Department of Agriculture
  - Forestry Section
- Delaware State College
- Department of Natural Resources and Environmental Control
  - Division of Soil and Water Conservation
  - Division of Fish and Wildlife
  - Division of Parks and Recreation
  - Division of Environmental Control
- Department of Health and Social Services
- Planning Research and Evaluation Division
- Office of Management, Budget and Planning

State of Virginia
- Agriculture and Commerce Department
- Division of Forestry
- Division of State Planning and Community Affairs
- Health Department
- Highways and Transportation Department
- Commission of Outdoor Recreation
- Soil and Water Conservation Commission
- Virginia Institute of Marine Science
- Commission of Game and Inland Fishery

Federal

U.S. Department of Agriculture
- Science and Education Administration
- Agricultural Stabilization and Conservation Service
- Economics, Statistics, and Cooperatives Service
- Farmers Home Administration
- Agricultural Cooperative Extension Service
- Forest Service
- Rural Electrification Administration
- Soil Conservation Service

U.S. Department of the Army
- Corps of Engineers

U.S. Department of Commerce
- National Marine Fisheries Administration
- National Oceanic and Atmospheric Administration

U.S. Department of the Interior
- Bureau of Commercial Fisheries
- Fish and Wildlife Service
- Geological Survey
- Heritage Conservation and Recreation Service
- National Park Service

Independent Federal
- National Aeronautics and Space Administration
- Environmental Protection Agency
- Smithsonian Institution

U.S. Department of the Navy
- Naval Academy

Organization

A plan of work for this study was prepared by the participating agencies of both the U.S. Department of Agriculture and the States of Maryland, Delaware and Virginia. It outlined a study structure which consisted of the USDA Field Advisory Committee, a Coordinating Committee and a Plan Formulation Committee.

In order to collect and analyze data it was necessary to formulate the following work groups:

1. Fish and wildlife
2. Priority areas
3. Land use

A. The Field Advisory Committee (FAC) guided and coordinated the Deaprtment of Agriculture survey activities. This committee was composed of the state conservationist, Soil Conservation Service, College Park, Md.; program leader, Northeastern Resource Group, Economics, Statistics, and Cooperatives Service, Broomall, Pennsylvania; and the field representative, Area Planning, Forest Service, Morgantown, West Virginia.

   The functions of the Field Advisory Committee were as follows:

   1. Coordinate the Department's survey activities and procedures
   2. Maintain necessary field liaison and coordination with other departments, USDA agencies, states, and other concerned entities to assure that USDA field work was properly coordinated with that of other participants
   3. Prepare the survey plan of work
   4. Arrange for participation in the study of other federal agencies as needed
   5. Interpret national guidelines, instructions, and procedures to meet the requirements of the survey in a uniform manner

6. Prepare, justify, and recommend project budgets to the Washington Advisory Committee

7. Compile periodic reports on program expenditures, and problems, as required by the Washington Advisory Committee and the parent agencies

B. The Coordinating Committee, consisting of representatives of USDA, USDI, Maryland Department of Natural Resources, Maryland Department of Agriculture, Delaware Department of Natural Resources and Environmental Control, and Virginia Soil and Water Conservation Commission was established. The sponsoring state agencies coordinated and provided leadership for the survey in their respective states. The State Conservationist for Maryland chaired this committee.

The main functions of the Coordinating Committee were as follows:

1. Define the objectives of the survey

2. Assist in the collection of data

3. Carry out studies assigned in the work outline

4. Arrange for participation of other federal and state agencies in the survey

5. Assist in resolutions of survey problems as they arise

6. Designate work groups when needed for specific phases of the survey

7. Make periodic review of progress

8. Select recommended plan based upon apparent public preference and in agreement with state and federal policies

9. Assist in report preparation

C. The Plan Formulation Committee membership was the same as the Coordinating Committee and was chaired by the river basins staff leader.

The Plan Formulation Committee served the function of establishing schedules, reviewing progress, and coordinating study activities. The committee evaluated alternatives and made recommendations for the suggested alternative presented in this study.

D. The purpose of the Fish and Wildlife Work Group was to collect, analyze, and develop information to resolve conflicts and enhance complementary situations involving fish and wildlife and other interests. Additional subgroups were established to accomplish this task. They included fish habiat, wetland habitat, wildlife priority areas, and the wildlife habitat analysis system.

These groups consisted of specialists from several agencies, universities, local and national environmental groups and representatives from public and private organizations.

E. The Priority Areas Work Group developed the criteria for assigning priorities within uses. Their functions were to develop criteria for assigning priorities to (1) the areas with water resource needs or problems, and (2) to areas of high biological, recreational, and scenic resource values.

The data for each of these areas was developed but time did not permit the second function, the evaluation of alternative measures, to be accomplished.

Subcommittees of this work group included Agriculture, Forestry, Biology, Recreation, and Development Potential.

This work group was comprised of the following:

1. Economics, Statistics, and Cooperatives Service, USDA (Chairman)

2. Soil Conservation Service, USDA

3. Energy and Coastal Zone Administration

4. Department of State Planning (three states)

5. Department of Natural Resources (three states)

6. Department of Agriculture (three states)

7. U.S. Department of the Interior

8. U.S. Forest Service

9. Fish and Wildlife Service

F. The responsibilities of the Land Use Work Group was as follows:

   1. Determine standards for mapping and tabulation of data

   2. Determine needs and base maps to be used by all participants in the survey

   3. Define criteria for establishment of land use

   4. Collect existing data on land use for each state

   5. Determine extent and detail of land use possible or practical to attain

   6. Project future land use for Peninsula

   7. Develop appropriate maps and tabular data

   8. Develop land ownership map for Peninsula

   The Land Use Work Group consisted of the following:

   1. Soil Conservation Service (chairman)

   2. Department of State Planning (three states)

   3. County planners

   4. Economics, Statistics, and Cooperatives Service

   5. U.S. Forest Service

   6. Department of Agriculture (three states)

   7. Department of Natural Resources (three states)

   8. Earth Satellite Corporation

   9. National Aeronautics and Space Administration

10. College of Marine Studies, University of Delaware

11. Wilmington Metropolitan Area Planning Coordinating Council

CHAPTER II - DESCRIPTION OF STUDY AREA

Physical

Location and Size

The Delmarva River Basins Survey area includes all of the Delmarva Peninsula south of the Chesapeake and Delaware Canal. This includes the Maryland counties of Worcester, Somerset, Wicomico, Dorchester, Talbot, Caroline, Queen Annes, Kent and part of Cecil; Sussex, Kent and part of New Castle counties in Delaware; and Accomack and Northampton counties in Virginia. Thirty percent of the survey area is in Delaware, 12 percent is in Virginia, and 58 percent is in Maryland. The total area of study is shown in Figure II-1.

The Delmarva Peninsula is approximately 174 miles from north to south and at the widest point is 74 miles from east to west. The region encompasses a 7,500 square mile area which contains approximately 3,565,000 acres of land and 1,282,000 acres of water.

The area is bound on the west by the Chesapeake Bay and on the east by the Delaware Bay and Atlantic Ocean. Major drainageways included in the area are: the Bohemia, Indian, Sassafras, Murderkill, Chester, Mispillion, Wye Mills, St. Jones, Choptank, Smyrna, Little Choptank, Transquaking, Nanticoke, Wicomico, Manokin, Big Annemessex, Leipsic, and Pocomoke Rivers.

Topography

The Delmarva Peninsula is relatively flat along the coastal and nearshore areas with gently rolling hills located in northern areas. Surface elevations range from zero to 150 feet above sea level. However, the majority of land area is less than 80 feet above sea level.

Physiography and Geology

The basins lie entirely within the Atlantic Coastal Plains physiographic province. Underlying the Coastal Plain are clays, silts, sands, and gravels, with some shell beds. These sediments were deposited mostly in a marine, off-shore environment, although some are of fluvio-deltaic origin. The total thickness of the sediments is 6,000 feet or more, overlaying a basement of crystalline rocks that

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are actually a continuation of the Piedmont, sloping seaward beneath the Coastal Plain at less than 80 feet per mile.

Deposits range in age from Cretaceous (60 million years old) to Recent. In order from oldest to youngest, the Coastal Plain formations are as follows:

1. The Patuxent Formation (Cretaceous), up to 4,000 feet thick, consisting of medium to coarse quartz sand and gravel, with gray and variegated clay layers

2. The Patapsco Formation (Cretaceous), 300 feet thick, of coarse quartz sand

3. The Nanjemoy Formation (Tertiary), 250 feet thick, of flauconite bearing quartz sands

4. The Calvert Formation (Tertiary), about 500 feet thick, of interbedded gray quartz sand and gray diatomaceous clay

5. The Yorktown Formation (Tertiary), up to 630 feet thick, of quartz sand and gravels with abundant shells at the base

6. The Columbia group (Quaternary), which overlays all the older formations

7. The Recent Formation (Quaternary)

The Columbia group is usually the only one exposed in this area. It consists of up to 160 feet of medium to coarse quartz sand and tends to be less marine and more continental in origin, i.e. it is largely fluvio-deltaic although some of it is barrier beach deposits. This group is essentially horizontal, truncating the sloping formations below which dip east southeast or seaward about five degrees. The Columbia is benched by several terraces left by successive drops in sea level during the Pleistocene epoch. River valleys eroded into the plain were inundated by sea level rise following the Pleistocene, hence the name "embayed section" for this part of the Coastal Plain.

Climate

A humid continental type of climate prevails throughout the Delmarva Peninsula because of its 43 inch average annual rainfall and its middle latitude location where a west to east atmospheric flow generally occurs. During the colder part of the year successive high and low pressure systems move along this flow to bring alternate surges of cold, dry air from the North and warm, humid air from the South. During the

the summer this pattern breaks as warm moist air travels from the South and Southwest through the North and remains much of the time. Extreme climate and temperature changes throughout the year are modified by the large water bodies of the Delaware Bay and the Atlantic Ocean on the east and the Chesapeake Bay and its tributaries on the west.

The rainfall distribution is fairly uniform throughout the year although long term records indicate the maximum monthly average is in August and the minimum monthly average is in October. Approximately 3 to 4 inches fall each month as shown on Figure II-2. Northern Delmarva experienced its annual rainfall low of 37 inches in 1965 while southern Delmarva witnessed its low of 24 inches in 1930. During 1948 a record 68 inches fell over Delmarva.

Thunderstorms occur on the average of about 30 days per year. While they may occur in any month, 65-75 percent usually occur in the four month period, from May through August. These storms are accompanied at times by heavy rain, damaging winds, hail and intense lightning.

Seasonal snowfall normally ranges from 10 inches in the southern portion to 13 inches in the northern portion. Seldom do these accumulations of snow remain on the ground for more than a day or two.

The mean annual temperature on the Delmarva Peninsula is approximately 56 degrees Farenheit. The monthly mean varies from 77 degrees F. in July to 35 degrees F. in January. Temperatures of 90 degrees F. or higher average 35 days annually. January, the coldest month, early morning minimum temperature averages near 24 degrees F.

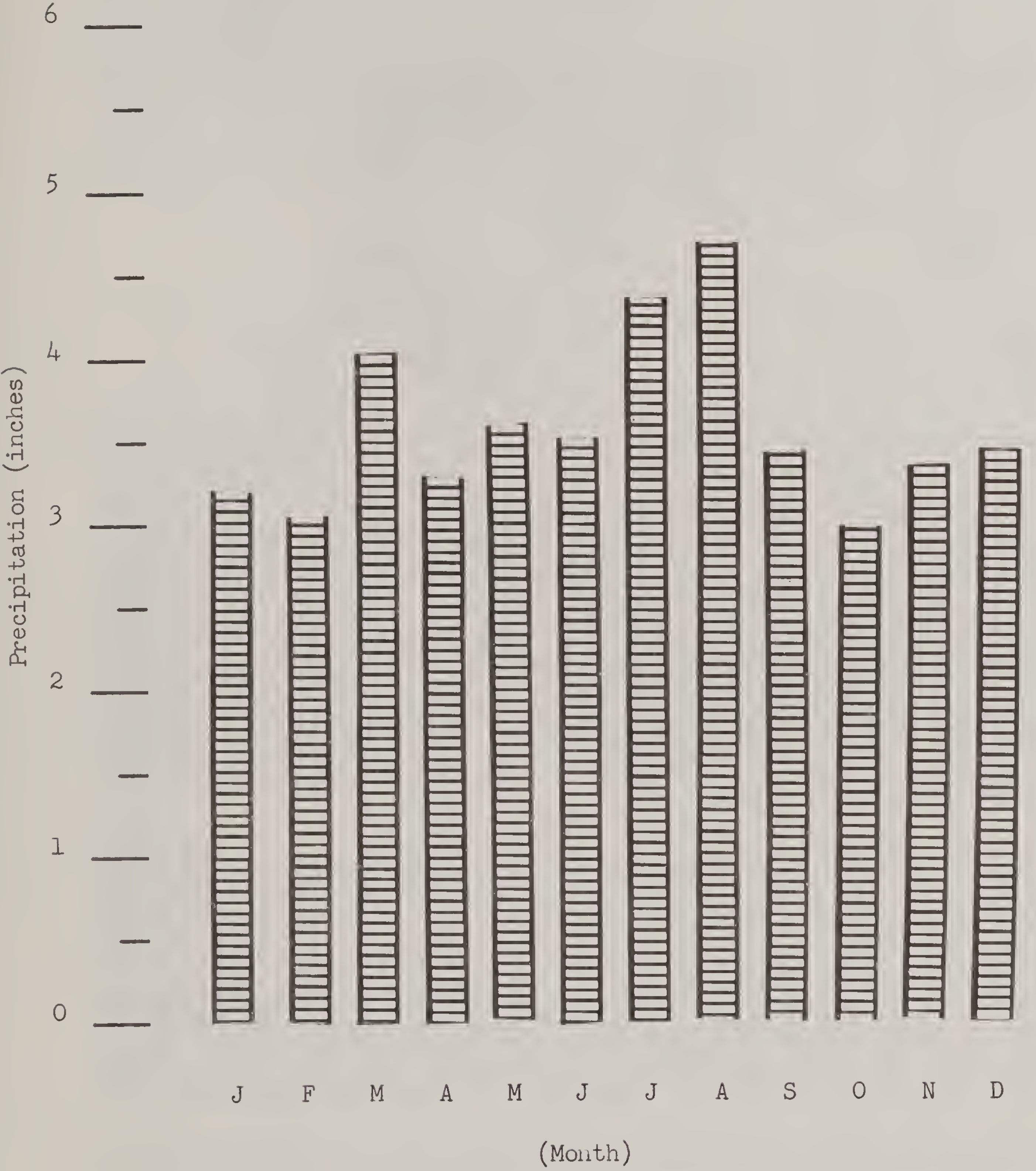
The peninsula's growing season ranges from 180 days to 225 days. The length of growing season is defined as the number of days between the last 32 degrees F. temperature in the spring and the first in the fall. This growing season generally extends from April or May to mid-October.

The prevailing winds are from the northwest to west except during the summer when the wind comes from a southerly direction. The average annual wind speed is about 8 miles per hour. The wind speed may reach 50 to 60 miles per hour or higher during summer thunderstorms, hurricanes or intense winter storms.

Natural Scenic Features

The most spectacular natural scenic features are associated with the bays and wetlands. The most impressive views are afforded from the Maryland Chesapeake Bay Bridge, the Virginia Chesapeake Bay Bridge-Tunnel, the Chincoteague Island Causeway and the Assateague Island Bridge. Views impress the traveler with the great scenic quality of the bays and wetlands interspersed with the upland pines and hardwoods.

Figure II-2 - Average monthly precipitation, Delmarva Peninsula.



From the island approaches, one can view the bay's water, wetlands, upland divisions and the ocean in the distance.

As the primary locus of the Atlantic Flyway, Chesapeake Bay is one of the key areas of the United States for the wintering and resting of migratory waterfowl and shorebirds. The greatest concentration of waterfowl is located on the Chesapeake Bay side of the Delmarva Peninsula where numerous wildlife refuges occur.

The Coastal Plain forestlands contain a wide variety of vegetative communities ranging from stands of pure pine to swamps dense with gum, maple and cypress. The interspersion of woodland with fields of soybeans, corn, and vegetable crops provides a visual resource.

Commercial Mineral Resources

The majority of mining activities are performed to extract sand, gravel, and borrow materials. Approximately 4,450 acres have been previously mined.

Limonite mining activities from 1830 until 1870 were centered around the bog iron ore deposits in the lower Eastern Shore. No further activities are anticipated.

Peat has been harvested from a bog in Kent County, Maryland but environmental and economic problems have precluded additional activities.

It is unlikely that fossil fuels will be found in substantial quantities in the basins. Land based oil drilling has been accomplished with no positive results. Off shore oil drilling operations could possibly succeed in tapping substantial quantities. Also, there is test drilling in progress for possible subterranean hot water deposits for thermal energy use.

Land Resources

Land Resource Areas

The Peninsula includes portions of two land resource areas: Atlantic Coastal Flatwoods 90 percent, and Northern Coastal Plains 10 percent. [1]

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1 U.S., Department of Agriculture, Soil Conservation Service, Atlas of River Basins of the United States, (Washington, D.C.: Government Printing Office, 1970), Maps 4 and 5.

The appeal of waterfowl attracts thousands of visitors yearly.

Most soils are sedimentary, acid, and low in natural plant nutrients. Forty percent of basins soils have a surface texture of sandy loam, thirty percent silt or silty clay loam, fifteen percent loam, and fifteen percent sand or loamy sand. Usually the very sandy soils are located on dunelike topography. Sandy soils are found on rolling topography, and silty soils occupy the more level areas at both higher and lower elevations. Surface topography has a greater influence on drainage classes of soils than does soil texture. Soils classed as very poorly drained, ranging from those developed in sand to those that developed in silt and clay, are usually found on nearly level landscapes. Very few acres of poorly drained soils are found on slopes greater than 2 percent, and these are in areas subject to seepage. After liming, fertilizing, and providing drainage when needed, most of the soils are highly productive for agricultural crops and pasture.

Soil Associations and General Suitability Interpretations

The Delaware and Maryland Agricultural Experiment Stations in cooperation with the Soil Conservation Service, have prepared general soil association maps for each county on the Peninsula. These maps give broad areas of soil groupings and dominant soils in each group and are designed only for general planning. General soil associations are displayed in each individual county survey. In an effort to update its present survey, Virginia has recently created a natural soil grouping map from their 1920 survey. Publications of natural soil groups for Maryland and Delaware are available through their respective state offices. Natural soil group maps can be obtained for Virginia but no publication is available.

In counties where detailed soil surveys are made, soils information can be used in managing farms and woodlands; in selecting sites for roads, ponds, buildings and other structures; and in judging the suitability of tracts of land for farming, industry and recreation. Soil limitation interpretations are included in the published county soil surveys. Copies of published soil survey reports and detailed soil surveys are available from libraries, Soil Conservation Service field offices, county agents, vocational agricultural teachers, and other sources.

Land Use Distribution

The Delmarva Peninsula has been relatively untroubled by the trend toward urbanization occurring in other rural areas adjacent to the Boston-Washington megalopolis. Agriculture is still the major single use of land on the Peninsula and imparts a distinctively rural character to the area. In the future, however, agriculture will face increasing competition for use of land.

The 1975 land use data developed through this study defined five major land uses:

1. Cropland and pastureland

2. Rural residential-commercial

3. Wetlands

4. Woodland

5. Other uses

These major uses were divided into sub categories to be used in the wildlife habitat analysis. There are 1,547,500 acres of cropland and pastureland (herbaceous), 223,400 acres of rural residential-commercial, 1,257,900 acres of woodland, 370,600 acres of wetlands, and 165,600 acres of other uses (includes farmsteads, roads, etc.).

Corn and soybeans dominate 84.3 percent of the cropland use. Cash-grain and poultry production are the most numerous type of farms on the Peninsula, representing 79.1 percent of total farms in 1974. Cropland uses vary throughout the Peninsula. Table II-A shows changes that occurred between 1959 and 1974 and the distribution of farm types across the Peninsula.

Commercial forest land is that forest land which is producing or is capable of producing crops of industrial wood and is not withdrawn from timber utilization. These acres represent 1,240,200 of the 1,257,900 acres of total forest land. Non-commercial forest land accounts for only 17,700 acres or 1.0 percent of total forest land. Non-commercial forest land is that forest land which is incapable of yielding timber crops because of adverse site conditions, and productive forest land that is withdrawn from commercial timber use through statute or administrative regulations.

About 12,400 acres of the Peninsula's commercial forest land are classed as non-stocked. This includes idle farm land reverting to forest, but still in brush transition stage, and stands of trees that are too poor in quality because of fire damage or other abuse. The distribution of the remaining commercial forest land is 756,500 acres sawtimber, 272,900 acres poletimber, and 198,400 acres of seedling and sapling size stands.

Water Resources

Surface Water

Surface water is a part of the hydrological cycle that results from

Table II-A - Type of farm and percent distribution, Delmarva Peninsula and subareas, 1959 and 1974.

Item	Delmarva		Delaware		Maryland		Maryland Upper Shore		Maryland Lower Shore		Virginia	
	1959	1974	1959	1974	1959	1974	1959	1974	1959	1974	1959	1974
All Farms [1]	14,221	7,896	5,203	2,988	7,758	4,323	3,863	2,117	3,895	2,206	1,260	585
Cash-grain	2,643	3,893	980	1,414	1,545	2,209	807	1,297	738	912	118	270
Dairy	1,951	501	728	167	1,213	334	1,105	312	108	22	10	0
Poultry	3,258	2,354	1,526	1,004	1,595	1,281	366	208	1,229	1,073	137	69
Other livestock	488	301	145	114	321	175	228	123	93	52	22	12
Vegetable	419	241	106	70	204	100	54	47	150	53	109	71
General	822	186	269	52	469	104	261	50	208	54	84	30
All other [1]	4,640	420	1,449	167	2,411	120	1,042	80	1,369	40	780	133
	Percent											
All Farms [1]	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Cash-grain	18.6	49.3	18.8	47.3	19.9	51.1	20.9	61.3	19.0	41.3	9.4	46.2
Dairy	13.7	6.3	14.0	5.6	15.6	7.7	28.6	14.7	2.8	1.0	.8	.0
Poultry	22.9	29.8	29.3	33.6	20.6	29.6	9.4	9.8	31.6	48.6	10.9	11.8
Other livestock	3.4	3.8	2.8	3.8	4.1	4.1	5.9	5.8	2.4	2.4	1.7	2.1
Vegetable	3.0	3.1	2.0	2.4	2.6	2.3	1.4	2.2	3.8	2.4	8.6	12.1
General	5.8	2.4	5.2	1.7	6.1	2.4	6.8	2.4	5.3	2.5	6.7	5.1
All other [1]	32.6	5.3	27.9	5.6	31.1	2.8	27.0	3.8	35.1	1.8	61.9	22.7

1 See the Census definitions for land in farms for 1959 and 1974 in Appendix B.

Source: Bureau of the Census, Census of Agriculture, 1959 and 1974.

precipitation. A primary indicator of surface water is stream flow. This stream flow is composed of both direct surface runoff and outflow of ground water into streams.

The average yearly rainfall of about 43 inches results in the average yearly runoff of about 15 inches. The remaining 28 inches is lost by evaporation or used by vegetation.

Selected gauged rivers and streams show a mean average discharge of 0.9 to 1.4 cubic feet per second per square mile. The various basins within Delmarva have been subjected to numerous floods and droughts throughout time. Records indicate that Hurricane Donna (1960) and most recently, Tropical Storm Agnes (1972) caused record flows throughout the basins. The most recent low flows that reflect drought periods occurred throughout the 1960's.

Surface water has generally not been developed as a source of water supply on the Delmarva Peninsula because:

1. Treatment may be required at times in order to control sediment and organic color.

2. Large supplies without reservoir storage are available only at a few sites.

3. Few opportunities exist to store streamflow and augment low flows.

4. Ground water is generally available everywhere on the Peninsula.

Thus, aquifers will probably remain the principal source of future water supplies. [2]

Ponds and Lakes: An estimate of the number of ponds was generated by a statistical sampling procedure which established the following quantities for all non-tidal water bodies. There are 3,248 ponds one-half acre or less in surface area; 2,749 ponds from one-half to three acres of surface area; and 479 ponds greater than three acres of surface area. Of these units, 6,289 are manmade; the remaining 187 are natural depressions which usually have centripetal [3] drainage. The total surface area of all lakes and ponds is 13,560 acres. Some of the larger water bodies date from the

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2 U.S. Department of the Interior, Geological Survey, Water Resources of the Delmarva Peninsula, Professional Paper No. 822, (Washington, D.C.: Government Printing Office, 1973), p. 53.

3 Centripetal - directed or moving towards a center or axis.

colonial period and most of these were constructed to harness water power for mill activities. The other ponds were constructed for such purposes as: scenic beauty, fish, waterfowl, irrigation, borrow pits, swimming, stock water, and fire protection. Many of the mill pond sites have become reforested or vegetated with a mixture of herbaceous and woody vegetation. Some of the mill dams are presently in poor condition.

Streams: Streams in the western and central parts of the Peninsula drain to the Chesapeake Bay, while the eastern part drains to the Delaware Bay and the Ocean. No streams or rivers drain more than 200 square miles before they become tidal. Most streams flowing east do not drain more than 25 square miles above tidal waters. Westward flowing streams in the northern Delmarva Peninsula have tidal flow almost to the headwaters.

Man has altered nearly all natural drainageways that were present when the land was settled over 200 years ago. In low lying areas, inter-basin connections in the headwaters of streams are not unusual.

Streams can be classified in four flow regimes:

1. Perennial - flow occurs at all times except during periods of extreme drought

2. Ephemeral - flow occurs only during and within 14 days following storm periods

3. Intermittent - flow occurs between the limits of 1 and 2 above

4. Standing water - water is impounded by blocked ditches or pools

The perennial streams are mapped and shown on wildlife display maps (Appendix A). In the past, environmental impact statements prepared for Delmarva PL 83-566 watersheds have shown that ephemeral and intermittent streams account for 60 to 90 percent of the flow regime. The majority of on-farm ditching is classified as ephemeral or intermittent.

Surface Water Quality

There is a tremendous amount of background data available on the water quality of the Peninsula. Some of the sources which should be referenced include the health departments of each state, annual water quality reports prepared pursuant to Section 305 (b) of The Federal Water Pollution Control Act of 1972 (PL 92-500), United States Department of the Interior Geological Survey, and the respective natural resource departments of each state.

Surface water quality can be interpreted by evaluation of chemical and biological parameters. Significant findings of the Maryland Fisheries Administration, Evaluation of the Effects of Channelization on Small Coastal Plain Streams of Maryland including discussion on benthic and chemical parameters of constructed and unconstructed stream systems, were related to surface water quality as follows:

Streams: The chemical water quality parameters of a stream are mainly a function of:

1. Atmosphere additions and exchanges
2. Rain water, dissolved salts and gases
3. Physical and chemical soil properties
4. The hydrology and amount of contact with the soil and associated soil constituents
5. The vegetation
6. Organic productivity of the stream
7. The tremendous diversity of man's activities
8. Terrestrial, avian, amphibious, and aquatic animal population

Surface water quality not only varies during the course of a year at each stream sample site but also from one site to another on each stream, and from stream to stream. Arithmetic mean values were calculated at each site in most studies. These mean values illustrate average conditions and do not define the water quality range which at times is most critical. The range of values from any group of streams is often misleading if applied to interpretive analysis. Physical or chemical factors unique to electrical conductivity did not vary significantly between constructed areas to more natural stream groupings. Channelized streams when compared to natural streams exhibited variation of water quality parameters on the same order as were exhibited by individual sites. Many parameters measured in the constructed and natural streams seemed to overlap. Similarities were often as significant as differences.

Data from various studies showed a positive correlation between the channel oxygen content and construction. The reason for this correlation is the increased photosynthesis resulting from an open canopy.

During summer dry periods the small unconstructed streams usually stop flowing and leave a series of stagnant pools with no surface flow. In contrast many constructed streams flow all summer because the increased depth permits intersection of ground water.

During low flow or stagnant periods turbidity in intermittent streams increased at many sites as a result of biological activity including water turbulence created by fish, invertebrates, amphibians, reptiles, and muskrats; and by phytoplankton production and concentration where open to light penetration.

Cyclic oxygen patterns are evident in unconstructed streams. The concentrations often become low during the summer to fall low-flow period. The isolated pools created during dry periods often lose detectable quantities of oxygen. In low-flow periods higher concentrations of ammonia, total organic nitrogen, phosphorous, and iron are expected.

"Levels of total hardness and total alkalinity were significantly related (positive) with years since channelization." [4]

The constructed streams on the average demonstrated lower color and higher dissolved oxygen.

Benthic organisms are constant indicators and therefore are often preferred over chemical indicators which fluctuate greatly. Benthic samples indicate the same relative water quality regardless of the season. There was no significant linear relationship between mean numerical (abundance) and mean wet weight (biomass) densities of benthic organisms and years since channel work was completed. Statistical T-tests showed no significant differences in mean numerical (abundance) and mean wet weight (biomass) densities between constructed and unconstructed streams. These statistical computations indicate that the channel work did not significantly reduce the standing crop of benthic organisms under the conditions found in this study.

Correlation coefficients indicated no significant linear relationships between species diversity of benthic organisms and years since completion of channel work for those streams less than sixteen years of age or for those streams greater than thirty-five years of age where no construction was performed.

The mean species diversity for unconstructed streams was significantly higher than that calculated for the constructed areas. There was a significant positive linear relationship between mean diversity of benthic organisms and years since channel work was completed.

Primary productivity [5] rates are low in swamp streams and oxygen

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4 Maryland, Fisheries Administration, Department of Natural Resources, <u>Evaluation of the Effects of Channelization on Small Coastal Plain Streams of Maryland</u>, 1976, p. 13.
5 Basic or primary productivity of an ecological system, community, or any part thereof, is defined as the rate at which radiant energy is stored by photosynthetic and chemosynthetic activity of producer organisms (chiefly green plants) in the form of organic substances which can be used as food materials.

concentrations do not vary much over each twenty-four hour period. Very low concentrations occur in wooded swamps due to the excess of respiration over photosynthesis and atmospheric absorption. The primary productivity of natural swamp streams is attributed to leaf litter.

Productivity in streams where channel work is complete comes from rooted aquatic plants, diatoms and other algae. Productivity is continual in streams without wooded canopies. Natural swamp streams rely on trees and leaf litter as the primary producers. Relative comparisons have been attempted but data is insufficient to permit a defensible statement as to which type of stream has the higher annual primary production. Further research needs to be accomplished to determine comparisons on energy systematics.

Present conditions on all streams sampled were within acceptable tolerance limits for many organisms expected to inhabit these types of ecosystems. The only nutrient value found to be above critical standards was that of nitrate nitrogen but no algae blooms were observed.

Ponds and Lakes: Water quality of ponds and lakes is generally considered to be good to excellent for recreational use. Exceptions occur including individual water quality problems with sedimentation and eutrophication on certain sites. Most ponds and lakes meet swimmable and fishable water quality standards. Studies are continuing to determine effects of non-point source pollution.

Ground Water

Ground water supplied by ten regional aquifers (water bearing units) and one or more water bearing sand beds of local extent is generally found everywhere on the Delmarva Peninsula. These ten aquifers furnish nearly 90 percent of the water used on the Delmarva Peninsula.

Most sub-strata dip generally in an eastward or southeasterly direction. When outcropping of the strata occurs, aquifers are subject to direct recharge from precipitation. Ground water recharge that is temporarily stored serves to maintain a base flow for the streams. When clays or other impermeable strata confine aquifers to create underground pressure, an artesian condition occurs.

Ground water occurs in the basins under both water table and artesian conditions. Water tables, however, almost exclusively receive ground water recharge.[6] A small portion of this is transmitted to artesian

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6 U.S., Department of the Interior, Geological Survey, Water Resources of the Delmarva Peninsula, Professional Paper No. 822, (Washington, D.C.: Government Printing Office, 1973), p. 53.

aquifers and the remainder is discharged from the water table aquifer by evapo-transpiration and movement of the ground water into streams, bays, and the ocean.

The bulk of the ground water discharge is considered base flow for streams. This base flow approximates the annual freshwater yield for aquifer systems. The U.S. Geological Survey has estimated that the base flow of streams on the Delmarva Peninsula is 8.5 inches per year. [7] On this basis it can be calculated that the fresh ground water yield exceeds approximately 2,600 million gallons per day (mgd) for the basins' 7,500 square miles.

For resource appraisal purposes it is important to know the range in well yields and specific capacities in the aquifers to have a rough evaluation of the quantities of ground water used in the region. This data is summarized in Table II-B.

A potential major ground water source was found between Delmar and Salisbury, Maryland during an investigation by the U.S. and Maryland Geological Surveys. The Salisbury (or Naylor Mill) paleochannel represents a substantial water supply that may extend into Dorchester County and perhaps into the upper Eastern Shore of Maryland. Testing has shown a thirty day yield of 4,000 gallons per minute and a transmissivity of 400,000 gallons per day per foot (53,500 $ft.^2$ per day). The paleochannel aquifer has a known length of 20 miles with a width range from 0.5 to 2 miles and a 80 to 200 feet strata respectfully. [8]

Ground Water Quality

The aquifers on the Delmarva Peninsula contain both fresh and brackish waters. In the upper Eastern Shore, freshwater is generally found in water bearing stratas throughout a depth of at least several hundred feet to more than 1,000 feet in some places. On the lower Eastern Shore, brackish water occurs in some places in aquifers at depths of 200 to 300 feet. At other places, such as Cambridge, Md., freshwater and brackish water aquifers are alternately layered. Precipitation infiltrates the ground and replenishes water lost from the aquifer during discharge to provide fresh water. Brackish water or saline water in aquifers is probably diluted sea water that entered the aquifer during the past; or water that has been trapped in the sediments. [9] Saltwater intrusions have occurred when water levels in the

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7 Ibid.

8 H. J. Hansen, "Project Proposal for the Further Hydrogeologic Evaluation of the "Salisbury Paleochannel" on the Eastern Shore of Maryland", February 23, 1977, p. 1.

9 U.S., Department of the Army, Corps of Engineers, Chesapeake Bay Existing Conditions Report, app. B, chap. 8, pp. 4-6.

Table II-B - Summary of aquifer data, Delmarva Peninsula.

Aquifer	Areal extent ($mi.^2$)	Area of use ($mi.^2$)	Potential area of use ($mi.^2$)	Estimated perennial yield (mgd)	Estimated withdrawals 1970 (mgd)	Range in transmissivity (ft^2 per day)	Range in coefficient of storage (ft^3/ft^3)
Nonmarine Cretaceous	2,500	750	1,750	80	18	550- 3,000	0.0001-0.0005
Magothy	2,200	400	1,800	10	2	500- 3,000	0.0001
Aquia and Rancocas	1,600	1,300	300	190	7	300- 5,000	0.0001-0.0004
Piney Point	2,000	1,100	900	(1)	9	1,200- 6,000	0.0002-0.0004
Cheswold	2,200	450	1,750	80	8	200- 4,000	0.0001-0.006
Federalsburg	2,200	500	1,700	50	3	450- 1,400	0.0001-0.003
Frederica	2,400	800	1,600	50	3	1,400	————
Manokin	3,500	1,200	2,300	(2)	6	950- 5,500	0.0001-0.0003
Pocomoke	2,150	1,600	550	(2)	6	1,000- 8,000	0.0001-0.003
Quaternary	5,950	5,950	0	1,040	61	100-50,000	0.0001-0.17

1 Included with Cheswold Aquifer.
2 Included with Quaternary Aquifer.

Source: U.S. Geological Survey, Department of Interior, Water Resources of the Delmarva Peninsula, Professional Paper 822, (Washington, D.C.: Government Printing Office, 1973), p. 55, Table 11.

aquifer have been drawn down below sea level. The reversal of the normal hydraulic gradients cause saline surface water to migrate landward. [10] This is a particular problem for the two Virginia counties where irrigation water supply needs to be located.

The major problem with the water resources of Delmarva are associated with quality rather than quantity although quantity will become a problem if use exceeds recharge. Quality seems to be stressed by chemical content of the water due to natural and man-caused phenomena. Some of the chemical elements which affect water quality for some uses are silicon dioxide, iron, manganese, calcium, magnesium, sodium, potassium, carbonate, carbonic acid, sulfate, oxygen, chlorine, fluorine, nitrate, phosphate, sodium chloride, calcium carbonate, and acidity. Some chemical elements are objectionable for certain uses - i.e., for domestic use. Any element in sufficient quantity to cause poor taste, smell or actual negative physiological responses is not only objectionable but at times a health hazard. The majority of all water usage originates from the underlying aquifers which range from poor to good in quality.

The chemical quality of the surface water and ground water on the Delmarva Peninsula varies with time and location. Two principal components of stream flow - base flow (ground water discharge) and overland flow (stream runoff) affect variations in water quality due to time. Variation due to location is affected by geology and the ground water flow pattern. A detailed discussion of the respective aquifers may be found in Water Resources of the Delmarva Peninsula, U.S. Geological Survey, Professional Paper 822, 1973.

As shown in Table II-B, the Quaternary aquifer is the most extensive, the most permeable, and the most productive in the area. The water from this aquifer has less than 100 milligrams per liter of dissolved solids. The water is suitable for most uses but in some areas may require iron removal. High concentrations of nitrate in shallow ground water indicate the susceptibility of the water table aquifer to contamination.

Water Use

Water is a major resource for municipal purposes, manufacturing, and agriculture. Municipal water systems provide for a variety of

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10 U.S., Department of the Interior, Geological Survey, Water Resources of the Delmarva Peninsula, Professional Paper No. 822, (Washington, D.C.: Government Printing Office, 1973), p. 49.

needs including domestic, commercial, industrial, institutional, and public uses. Most manufacturing water is used for cleaning and cooling with very little water intake being embodied in the product or lost to the atmosphere as evaporation or transpiration. Agricultural water use is consumptive to the extent that it is used for irrigation, livestock and poultry consumption, and domestic purposes. Compared to manufacturing use of water, agricultural use presently has a greater impact on water supply particularly when large acreages are irrigated.

Municipal Use: Table II-C lists many of the treated municipal water systems on the Delmarva Peninsula that serve a municipality having a population of 2,500 or more. These systems serve approximately 70,300 people in municipal and community districts. Wide variation in per capita use rate is apparent in the systems listed. The high rates in Cambridge and Salisbury, Md. are indicative of industrial use. In Crisfield, Md. the high rate is attributed to another component of water use - leakage. This town has an approximate 25 percent loss due to leakage. [11] The remaining rates (80-155 gallons per capita per day) typify an "average mix" of residential, industrial, and commercial activity.

Smaller public systems (less than 2,500 population) with aggregated populations and rural residential water use with private wells are not shown.

Industrial Use: Industry accounted for an intake of 102.7 million gallons per day (mgd) on the Delmarva Peninsula in 1970. Many industries own and operate their own water supply system and therefore extracted only 6.0 mgd from municipal systems. An intake of 46.0 mgd came from self-supplied ground water and 49.1 mgd came from self-supplied surface water. Most of the self-supplied surface water systems are used by industries in Kent and Sussex Counties, Delaware. The whole industrial sector used only 0.8 mgd from brackish sources. [12]

Agriculture water use for the Chesapeake Bay study area, which includes the Delmarva Peninsula, was estimated for the years 1950, 1960 and 1970. The following sections summarize the three components of rural water use - rural domestic; livestock and poultry; and irrigation.

Rural Domestic Water Use: Between 1950 and 1970 the domestic population was a major user of water in rural areas. By the 1970 Census of Population definition, the rural domestic population is composed of a

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11 U.S., Department of the Army, Corps of Engineers, Chesapeake Bay Future Conditions Report, 5:13, app. 5.
12 Ibid., 5:25-30, app. 5.

Table II-C - Municipal water use, 1970 (> 2,500 population).

Subregion and water service area	Population served, 1970	Average use, (mgd)	Per capita use (gpcd)
Maryland			
Cambridge	12,600	3.85	305
Centreville	2,800	0.28	97
Chestertown	4,000	0.53	132
Crisfield	4,040	1.37	339
Delmar	3,000	0.30	100
Denton	2,700	0.39	144
Easton	7,800	1.00	128
Pocomoke City	3,330	0.30	90
Princess Anne	2,500	0.22	88
Salisbury	19,000	4.00	210
Snow Hill	3,000	0.47	157
Subtotal	64,770	12.80	157
Virginia		No large public systems	
Delaware [1]			
Seaford	5,540	0.84	153

1 Data information for Delaware is limited to Sussex County.

Source: U.S. Department of the Army, Corps of Engineers, Chesapeake Bay Future Conditions Report, 5:14-15, Table 5-1, app. 5.

rural farm component and a rural nonfarm component. All rural residents living on farms were classified as rural farm, while the remaining rural population was categorized as rural nonfarm.

In 1950 the rural population on the Peninsula was 332,299 and by 1970 had increased slightly more than 20 percent to 400,319 (Table 1, Appendix B). The rural nonfarm population comprised 70.4 percent of the rural population in 1950, 84.5 percent in 1960, and 92.2 percent in 1970. During this period the official rural nonfarm population count increased in the Northeast due to two major factors:

1. The increased development of rural areas

2. Changed Census definitions that narrowed the "rural farm" classification

Rural domestic water used by county for 1950, 1960, and 1970 is shown in Table 25 of Appendix B, Socio-Economic Base Report. Total rural domestic water use on the Peninsula rose from 3,215.2 million gallons annually in 1950 to 6,377.0 million gallons annually in 1970, an increase of 98.3 percent. The differences among counties for each year reflect differences in rural population by county and the proportion of county residences with and without running water in the stated years.

<u>Livestock and Poultry Water Use</u>: Another component of agricultural water use is water used by livestock and poultry. Water is required to sustain these animals and to enable production of livestock and poultry products marketed by Peninsula farmers.

Annual water use estimates for livestock and poultry by county for 1959, 1969, and 1974 are shown in Table 26 of Appendix B. Total livestock and poultry water use rose from 1,863.9 million gallons in 1959 to 2,161.6 million gallons in 1974, an increase of 16.0 percent. Table 27 of Appendix B further illustrates county trends in livestock and poultry water use by species for the period 1959 to 1974. For the Peninsula as a whole, only cattle and calves, hogs and pigs, chickens three months and older, and broilers used substantially more water in 1974 than in 1959. Water used by milk cows decreased substantially because of a drastic reduction in the number of milk cows. This occurred despite an increase in per capita water use by milk cows between 1959 and 1974. Higher milk production rates per cow and greater use of water for sanitary purposes on dairy farms were primarily responsible for increased per capita water consumption by milk cows during this period.

The percentage of total livestock and poultry water use accounted for by the consumption of each species in 1959, 1969, and 1974 is shown in Table 28 of Appendix B for the Peninsula as a whole and for each of the subareas. In 1959 consumption by cattle, calves and milk cows

accounted for more than 60 percent of livestock and poultry water use, but in 1974 accounted for only slightly more than 40 percent. Broilers, on the other hand, used about 25 percent of the water in 1959, but nearly 40 percent in 1974. Trends within all Peninsula subareas showed similar shifts in water use among animal types.

Irrigation: On the Delmarva Peninsula, irrigation is commonly used for vegetables, potatoes, and nursery crops. As in other humid areas of the United States, irrigation of field crops such as corn and soybeans or pasture and hay crops is generally practiced by only a few farmers. In terms of water use, however, irrigation of only a small proportion of harvested cropland can require large volumes of water. One inch of water applied to one acre (an "acre-inch") is equivalent to 27,200 gallons - which would sustain a herd of 25 milk cows for a month at the rate of 35 gallons a day. Moreover, irrigation is a consumptive use of water. Depending upon the efficiency of application, from 65 to 90 percent of the water applied will be used as evaporation or transpiration. Present technology has provided additional systems of irrigation, such as the drip system which requires far less water and energy. However, the initial and high maintenance costs of this system limits widespread use.

Estimates of irrigation water use on the Peninsula are based on irrigation data from the Census of Agriculture for the years 1969 and 1974. Data on the number of Peninsula farms using irrigation, acreage irrigated, and water used are presented in Table 29, Appendix B. Comparison of Table 29 with Tables 25 and 26 (Appendix B) indicates that irrigated water use in 1974 was 96 percent of rural domestic water use in 1970 and consumed 2.8 times the water use of livestock and poultry in 1974. Table II-D indicates data on irrigated acreage by crop for 1974. Of the 43,448 acres irrigated in 1974, 25,489, or 59 percent, were in vegetables; an additional 7,232 acres, or 17 percent, in Irish potatoes; and 7,139 acres, or 17 percent, in corn and soybeans.

Total agricultural water use in 1969-70 was 14,903.7 million gallons. Of this total, 42.8 percent was rural domestic water use; 14.8 percent was used by livestock and poultry; and 42.4 percent was irrigation use. Analysis of existing trends indicate that the rate of increase in agricultural water use in the future will decline. A decrease in water use cannot be expected unless there are dramatic shifts in the Delmarva agricultural economy.

Table II-E shows major water use on the Delmarva Peninsula for both the urban and agriculture sectors.

Table II-D - Acreage of irrigated crops, Delmarva Peninsula, 1974.

Area	Cropland pasture	Corn	Soybeans	Wheat	Barley	Hay	Irish potatoes	Veget-ables	Orchard berries	Nursery & other	Total
	Acres										
Delmarva Peninsula	116	3,323	3,816	639	508	161	7,232	25,489	428	2,095	43,807
Delaware	47	1,418	2,055	374	90	17	3,573	12,212	293	238	20,317
Kent	17	305	918	206	-	7	3,264	7,258	58	188	12,221
New Castle	15	1	-	-	-	-	305	308	19	10	658
Sussex	15	1,112	1,137	168	90	10	4	4,646	216	40	7,438
Maryland	69	1,758	1,685	250	418	144	4	9,798	100	1,557	15,783
Upper Shore	54	1,493	1,101	140	243	53	1	6,626	43	1,103	10,857
Caroline	4	915	1,021	140	237	3	1	5,107	36	303	7,767
Cecil	-	-	20	-	-	-	N.A.	N.A.	-	23	43
Kent	-	150	-	-	-	50	-	N.A.	-	675	875
Queen Annes	50	388	50	-	-	-	-	1,474	7	50	2,019
Talbot	-	40	10	-	6	-	-	45	N.A.	52	153
Lower Shore	15	265	584	110	175	91	3	3,172	57	454	4,926
Dorchester	-	45	521	70	175	82	2	1,878	27	100	2,900
Somerset	-	70	35	-	-	-	-	115	15	42	277
Wicomico	13	-	28	40	-	9	1	1,179	15	312	1,597
Worcester	2	150	-	-	-	-	-	-	-	-	152
Virginia	-	147	76	15	-	-	3,655	3,479	35	300	7,707
Accomack	-	22	16	-	-	-	1,510	2,656	-	168	4,372
Northampton	-	125	60	15	-	-	2,145	823	35	132	3,335

N.A. - signifies not available.

Source: Bureau of Census, 1974 Census of Agriculture.

Gun irrigation systems are popular due to lower initial investment.

Center pivot irrigation systems require a larger initial investment but operate at a higher efficiency.

Table II-E - Major water use, Delmarva Peninsula, million gallons per day.

Area	Urban	Agriculture		
	Municipal systems with industrial use (>2,500 population) 1970	Rural domestic use 1970	Livestock and poultry—1974	Irrigation 1974
Delmarva Peninsula	13.6	17.5	5.9	16.8
Delaware	0.8	7.8	2.2	7.0
Kent	N.A. [1]	2.7	0.4	4.0
New Castle	N.A. [1]	1.9	0.2	0.2
Sussex	0.8	3.1	1.5	2.9
Maryland		8.2	3.6	6.4
Upper Shore	2.2	4.6	1.9	4.1
Caroline	0.4	0.8	0.4	2.8
Cecil	0.0	1.8	0.5	0.2
Kent	0.5	0.5	0.4	0.3
Queen Annes	0.3	0.7	0.4	0.7
Talbot	1.0	0.7	0.2	0.1
Lower Shore	10.6	3.6	1.7	2.3
Dorchester	3.9	0.7	0.2	1.1
Somerset	1.6	0.6	0.3	0.2
Wicomico	4.3	1.7	0.6	0.9
Worcester	0.8	0.7	0.5	0.03
Virginia		1.4	0.2	3.3
Accomack	No large public systems	1.0	0.1	1.8
Northampton	No large public systems	0.5	0.02	1.5

1 Not available.

Source: Delmarva River Basins Staff.

Wetlands

Wetland is a term which encompasses a wide range of hydrologic, botanical and physical variations. The main factor is an abundance of water but even this is greatly variable. Wetland variability is usually expressed in botanical features. Physical features including soil structure, water diversions, tile lines, reverse berms, open ditches, land leveling, impoundments, road beds, and diking all contribute to controlling the hydrologic condition. Wetlands can be created or destroyed by modification of these physical features. Wetlands have been recognized for their values by legislation that has been developed to protect them.

The Delmarva Peninsula is gifted with an abundance of wetlands - some of which are almost pristine. However, most wetlands display physical evidence of man's activity. Some evidence is vivid such as constructed drainage ditches in once wooded swamps or the mosquito ditches in open marshes. Other evidence is subtle such as the mill logs that sank and are now covered with up to five feet of marsh sediments or the effects of man-induced fire, burning away at the organic mats, leading to greater inundation of marsh land. Wetlands are not static in nature and are continuing to change. Since the first mapping of Somerset County, Maryland it has been estimated that 35 percent of the total land base became submerged. This 35 percent must have been wetland types at one time or another. Presently Somerset County still has vast wetland acreage much of which has been derived from upland sources including cropland. Land subsidence or the raising of the sea has contributed to erosion along the shore and loss of land to water. It is evident that in areas such as Somerset County that a one foot increase in the water elevation, in a county where the highest point is 29 feet above sea level, would inundate a large acreage. The present average rate of water elevation increase is estimated at one foot in 100 years. [13]

It has been argued that man's activity has led to massive destruction of wetland on the shore and indeed bulkheading, drainage, road building, construction, impoundments, port construction, spoil deposition and other activities are evidence. At the same time wetlands are being lost through natural subsidence and erosion. Wetlands are also being created through natural subsidence and deposition of eroded materials.

Wetland gains are apparent in the aggregation of sediments in low energy shoreline areas and the filling of waterways. The greatest wetland gain is through conversion by inundation of woodland and cropland. Man has increased wetlands by management of spoil deposition,

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13 Ibid., 8:10, app. 11.

construction activities, and the creation of 13,000 acres of ponds with their associated submerged and emergent aquatic vegetation.

The balance between loss or creation of wetlands is unknown. A good data base quantifying wetlands and locations needs to be developed. Continual follow-up studies should be scheduled to monitor changes and to suggest management options, so that knowledge will be available for decision makers.

Present inventories of wetlands are fragmented by regional divisions and uncoordinated identification procedures. The three states in which the study was compiled have wetland surveys all with variations and all with points of merit. Ongoing activities of the three states coupled with Coastal Zone Management Programs, EPA, Chesapeake Bay Study and Interior's mapping efforts should meet future inventory needs.

The one wetland mapping effort which is consistent for the total study area is that which was accomplished in developing the soil survey. It is limited because it places all tidal wetlands into one category and does not attempt to classify interior non-tidal types. For the purpose of this study it was determined that the soil survey would suffice as the mapping effort for the tidal areas. A key was developed for separation of wetland Types 1 and 2 (as established by USDI Circular 39) from all others. The work group composed of state and federal agencies determined the separations after consideration of significant physical and botanical features.

There are approximately 101,600 acres of tidal influenced wetlands on the Peninsula as shown in Appendix A. The interior wetlands are not completely mapped by any system. There are various systems which identify aspects of the total wetland picture. The total interior wetlands data was developed by taking certain soil groups and determining the percentage of that soil group which generally occurs as a wetland. Seventy-three percent of the wooded soils (Johnston Silt Loam, Muck, Swamp, Tidal Marsh, Mixed Alluvial Land, Muck and Peat, St. Johns Loamy Sand, Pamlico Muck, Meadow) had properties which identified them as wooded wetland areas. A watershed interpretive chart of interior wooded wetlands is in Table II-F. These soils were previously or are presently wetland types. Man's modification of the associated wetland physical features such as the cutting of woodland on Type 7 sites or the drainage of Type 8 bogs has changed many of these wetland areas. The vegetative changes of a Type 7 induced by woodland cutting are only temporary. The hydrologic regime changes but not to the extent of changing a wet site to a dry site classification. The site will often deviate from the normal vegetative successional stages and proceed from a wetland herbaceous community and then progress to a woodland climax. The drainage of the Type 8 site has a different effect in that it will lose the

Delmarva has an abundance of coastal wetlands.

Meaningless destruction of wetlands should be discouraged.

Table II-F - Interpretive chart of interior wooded wetlands,[1] Delmarva Peninsula.

Watershed name and CNI number	Wetland acres	Watershed name and CNI number	Wetland acres	Watershed name and CNI number	Wetland acres
0108 Chesapeake E.	2,053	0109 Corsica R.	547	0110 Wye Mills	46
0113 L. Chesapeake	3,102	0114 Upper Manokin	46	0115 Kings Creek	319
0116 Turkey Branch	91	0117 Marumsco	228	0120 Upper Virginia	456
0120-1Bullbeggar Crk.	182	0120-2Holdens Creek	137	0120-3Jacks Creek	91
0120-4Messongo Crk.	319	0120-5Cattail Creek	16	0120-6Muddy Creek	91
0120-7Guilford Crk.	46	0120-8Pungoteague Crk.	228	0129 Lower Virginia	730
0203-1Smyrna River	456	0203-2Blackbird Creek	319	0203-3Appoquinimink R.	502
0203-4Other Areas	319	0203-5Cedar Swamp	10	0204 Leipsic	3,330
0205 Murderkill	1,733	0206 Mispillion	730	0207 Broadkill	2,737
0301 Indian River	4,972	0302 Bear Hole	182	0307 Lower Virginia	547
0307-1Tommys Ditch	12	0308 L. Chincoteague	1,551	0318 Chincoteague	1,049
0318-1Turville	46	0319 Shingle Landing	274	0320 Kitts-Taylorville	182
0406-1Bohemia River	456	0406-2Sassafras River	1,094	0406-30.A.-Back Creek	274
0406-40.A.-Crystal Be.	410				
0501 Andover Br.	1,916	0502 Chester River	2,463	0503 Unicorn Branch	274
0504 Dudley Branch	274	0505 Radcliffe R.	182	0506 Church Hill Br.	365
0507 Granny Find. Br.	502				
0601 Upper Choptank	684	0602 Goldsboro	91	0603 E. Goldsboro	502
0604 Forge Branch	365	0605 Garland Lake	228	0606 Ridgely	7
0607 Watts Creek	958	0608 Neck	46	0609 Williston	182
0610 Harmony	46	0611 Long Marsh	684	0612 Germans Br.	958
0613 Jumptown	547	0614 Blackton Br.	365	0615 Norwick Br.	11
0616 Hillsboro	182	0617 Tuckahoe	502	0618 Lower Choptank	1,505
0619 Bethlehem	365	0620 Preston	91	0621 Cabin Creek	410
0622 Warwick River	46				

Table II-F - Interpretive chart of interior wooded wetlands, [1]
Delmarva Peninsula.

Watershed name and CNI number		Wetland acres	Watershed name and CNI number		Wetland acres	Watershed name and CNI number		Wetland acres
0701	Upper Nanticoke	2,600	0702	Middle Nanticoke	775	0703	Broad Creek	2,007
0704	Sharptown	912	0705	Marshyhope	1,733	0706	L. Marshyhope	1,551
0707	L. Nanticoke	912	0708	Barren Creek	593	0709	Rewastico Reek	319
0710	Quantico Creek	228	0711	Wetipquin Crk.	46			
0801	Upper Pocomoke	1,733	0802	Green Run Br.	456	0803	Middle Pocomoke	8,302
0804	Aydelotte	593	0805	Franklin Br.	46	0806	Powellville	684
0807	Timmonstown	182	0808	Ninepin	137	0809	Coonfoot	137
0810	Nassawango	2,920	0811	Dividing Creek	2,327	0812	Blackdam	365
0813	Lower Pocomoke	2,783	0814	Rehobeth Br.	274			
0901	Johnson Lake	456	0902	Beaver Dam	593	0903	Pemberton	137
0904	Tony Tank	102	0905	Siloam	228	0906	Passerdyke Crk.	46
0907	Upper Wicomico	228	0908	Lower Wicomico	365			
1001	Upper Chicacomico	319	1002	Chicacomico R.	1,597	1003	Fishing Bay	684
1004	Transquaking R.	1,231	1005	Middletown Br.	182	1006	L. Blackwater	228
1007	Blackwater R.	1,140						

1 Through investigation of an identified group of soils it was determined that approximately 73 percent of these wooded soils had properties which identified them as wooded wetland acres.

Source: Delmarva Wildlife Work Group.

wetland classification being converted to cropland or other land uses. To retain this conversion continual maintenance is necessary to assure the hydrologic condition does not revert. If the hydrologic condition is allowed to revert then the vegetative community will return. Wetlands are a product of the management of physical features and tile lines or drainage ditches can interrupt the physical barrier which impedes water flow.

Forested wetlands are classified as either wet flats, bottomlands, bays, or swamps. These sites all have one thing in common - they reflect the dominating influence of saturated soils seasonally or otherwise. Beyond this common feature, however, they may vary widely from one locality to the next, each with its own peculiar combination of landform, soil vegetation, hydrology, and wildlife.

The two major groups on the Peninsula are wet flats and bottomland. Wet flats are upland sites located on the broad, level to nearly level, areas of the lower Coastal Plain region. The primary source of water for these areas is precipitation which accumulates on or in the soil for long periods. Water moves slowly through the soil because of slowly permeable subsoil layers, lack of soil profile development, insufficient hydraulic head between the soil surface and stream flowline, or some combination of these factors. Although wet flats are somewhat poorly to poorly drained, their wetness is seasonal and they frequently alternate in being excessively wet or dry. The dominant forest vegetation on the wet flats of the Peninsula range from pure stands of loblolly pine to pure stands of hardwoods. Under natural conditions pine would tend to dominate those sites where soils are coarse-textured and low in colloidal clay and humus; hardwoods or pine-hardwood types would be predominant on the soils with higher water holding capacity and cation exchange capacity. Understory vegetation in many cases is extremely dense. The wet flat sites are the ones most closely studied from the standpoint of benefits to forest landowners by providing outlets for controlled drainage. Forest research has concentrated on providing information to guide woodland owners in their efforts to increase the productivity of wet flats for trees.

The other major wetland type on the Peninsula is bottomland. These are the areas that have larger channels than wet flats to carry storm flow to the sea. Land surfaces are characteristically flat with slight differences in elevation that produce large differences in drainage conditions, soils, and vegetation. Bottomlands are wetted by precipitation, seepage, and overflow. The soils are developed by deposition of water-borne sand, silt and clay which results in typically indistinct soil profiles. The fertility of these sites is usually excellent. Research has shown that productivity for certain species of timber and wildlife is unexcelled because of the inherent fertility and abundant moisture of bottomland soils. Site changes resulting from intensive drainage affects profound changes on stand composition, tree growth, and regenerative potential. Knowledge of

cause and effect, however, is limited and, because of this, recommended water management measures are limited to those likely to increase the amount of soil water available for plant growth. These bottomlands are the sites through which the drainage on the wet flats are routed or which serve as outlets for the drainage from the wet flats.

Fish and Wildlife

Saltwater Fisheries

The great diversity of the Delmarva Peninsula's saltwater fishery is partially explained by the diversity of habitat types that occur. The Atlantic Ocean and its coastal characteristics offer a fishery typified by surf clams, lobsters, and sea bass. The small coastal bays and associated wetlands are noted for clams, oysters, and flounder. Delaware Bay is recognized as one of the best waters for sea trout. The Chesapeake Bay is considered one of the world's richest estuaries and as such supplies a great treasure in seafood to its users and acts as a nursery ground for many ocean species.

Historically, the oyster (Crassostrea virginica), has held a dominant position in fishery production. Management and regulation of this species is practiced. Additional management activities for the purpose of increasing production of additional species or enhancement of the habitat can be seen in the construction of artificial reefs and the seed clam program that have been initiated in Maryland. The potential productivity of the Chesapeake Bay is high. At a recent meeting between Japan and the United States, a Japanese delegate reportedly said that Japan could feed the world if they owned the Chesapeake Bay.

Freshwater Fisheries

The freshwater fishery habitat was segregated into three major divisions:

1. Ponds and small lakes
2. Non-tidal freshwater systems
3. Tidal freshwater areas

Ponds and Small Lakes: The ponds and small lakes are capable of sustaining a productive fishery. There are over 6,000 of these water

bodies which total 13,560 acres. There are 3,250 ponds one-half acre or less, 2,750 ponds from one-half to three acres and 480 ponds greater than three acres. Many of these can support a sport fishery. There are productivity limitations placed on the small ponds but if managed properly they can supply hours of fishing. Citation fish [14] have been attained year after year. The following are citation fish from farm ponds: 9 lb. 10 oz. largemouth bass, 2 lb. 11 oz. bluegill, 7 lb. 4 oz. chain pickeral, and a 3 lb. 14 oz. crappie. Pond management for citation fish is not usually consistent with the greatest productivity. Management of the Delmarva farm ponds can be typified by example. One farm pond was constructed in 1958 and stocked with a bass and bluegill combination. The pond was not fished until 1961 and good success was attained for three years. A drastic decline began the following year as the bluegill population increased tremendously because of the loss of the predator bass population. The following years showed no sign of improvement and to the owner's knowledge no one has fished the pond since 1969, and no additional management was accomplished since it was stocked. Approximately 46 percent of the farm ponds are not fished on Delmarva each year due to the following reasons:

1. Poor management

2. Preference for tidal saltwater fishing

3. Lack of public awareness

4. Lack of accessibility

Approximately 49 percent of the farm ponds are fished one or two times a year. Approximately 5 percent of the farm ponds are fished in a manner that exceeds good management practices.

Non-tidal Freshwater: The non-tidal freshwater systems received considerable attention due to the controversy over effects of channel work on the resident fish population. Because specific regional channel work impacts on the fish population was not available the Soil Conservation Service assisted the Maryland Department of Natural Resources Fisheries Administration in designing and developing a study. The study was titled:

Evaluation of the Effects of Channelization on Small Coastal Plain Streams of Maryland.

The Soil Conservation Service also initiated a contract study pre-

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14 Citation fish - fish of such size and/or weight to receive mention or recognition.

pared by Ecol Sciences, Inc. titled:

> An Assessment of Economic and Environmental Effects of Completed PL 566 Channel Modification Projects in Worcester and Wicomico Counties, Maryland.

These studies and other cooperative studies accounted for the development of data from over 90 sites.

An analysis of non-tidal stream studies and other available data revealed that for streams up to a 10,000 acre watershed area there was no statistically valid difference in fisheries between recently constructed work and streams that had been left in a more natural condition or had not been reworked for a time span long enough for vegetation to recover.

It was determined that the resident fisheries in watersheds less than 10,000 acres would probably not suffer any long term detrimental effects from construction.

In some cases, unique and valuable fish habitat occurs in the smaller streams, and such areas must be identified prior to any project activities. Unique habitats may be limited to perennial streams with:

1. Gravel bottoms or riffles, or
2. Channels with undercut banks for 10 percent or more of any half mile segment

If these factors are apparent, additional investigations should be accomplished to determine presence or absence of rare or valuable species. Non-tidal streams, with greater than 10,000 acres drainage, should be intensively investigated if any construction activities are planned. Work was accomplished to determine which stream chemical and physical variables produced the greatest correlation with fish population biomass. Those variables that were found to have the greatest correlation with fish biomass are listed in order of importance:

1. Standard deviation of water depth
2. Instream cover
3. Water depth
4. Time since project activity
5. Degree of bank vegetation
6. Percent of stream shaded
7. Aquatic vegetation cover
8. Bottom material

9. Water width

10. Size of drainage area

From these variables predictive equations for diversity indices and mass were formulated. These equations and their rationale are found in a report titled:

<u>The Analysis of Delmarva's Fishery Data</u>

The report is available upon request from the Maryland Soil Conservation Service State Office in College Park, Maryland.

<u>Tidal Waterways Under 1,000 Acres</u>: In small tidal watersheds of less than 1,000 acres, there are certain factors which should be taken into consideration. One such factor usually considered beneficial is the increased access for fish after construction. A conflicting value exists in construction of some ditch systems, where they outlet on the upper marsh. If the channel is deep it acts beneficially in trapping sediment and requires less frequent maintenance. It can also act negatively as a fish trap during times of low tide where fish can deplete the oxygen supply and die. However, the benefits of a deeper constructed system outweighed potential damages.

<u>Tidal Waterways Over 1,000 Acres</u>: Data is limited on tidal waterways over 1,000 acres and further study is needed to define ecological effect of channel enlargement in these systems. If inland wetlands are not detrimentally affected by construction, slight negative effects, if any, are anticipated to the resident fish in the larger tidal systems.

Any work that contributes sediment to tidal waters, during or immediately after anadromous fish runs, is detrimental. The extent of potential damages is under investigation but it is thought to be proportional to the amount of sediment generated.

Attempts should be made to schedule construction activities to avoid such periods as much as possible while realizing there are difficulties in construction schedules. It is recognized that there are situations where it is more preferable to complete a construction activity than it would be to discontinue it only to start it up again.

Wildlife Resources

Wildlife habitat is in a continual state of change. Factors which contribute to these changes can be grouped into four categories. The management oriented category include forestry practices, agronomic

practices and wildlife management. Category two, man induced, includes disturbance and pollution. Category three can be titled natural events and includes: hydrologic changes resulting from aggradation of water courses, tidal influence increase due to land subsidence and water level increase, disease outbreaks, insect damage, and meteorological effects including wind or ice storms, and fire. Category four is land use changes or conversions that include abandonment, forest clearing, construction and tree planting. Floral and fauna successional changes occur in conjunction with factors above or individually in sequence through cyclic changes from youthful communities stages to climax communities.

The Delmarva survey concluded that to adequately manage wildlife one must determine present habitat units and predict what changes these units would incur over various time spans. Only with a sound data base can management activities be directed.

The Delmarva survey developed a Delmarva Wildlife Habitat Analysis System to be used as a planning tool for management strategy. The development and use of this system has been published in the 1977 proceedings of the annual conference of the Southeastern Association of Fish and Wildlife Agencies. The complete system can be found in Appendix C.

The actual hours spent utilizing the wildlife resource either consumptively or nonconsumptively is difficult to quantify. The fact is that it is intensive and the trend is growing at a pace at least equal with population and income. The availability of the species to the public determines use. Those areas with greater visibility and availability for the consumptive uses will unavoidably grow in use. In an area like Delmarva with its adjacent large population centers, there is slight limit to possible users who could be summoned by a large and accessible resource.

Rare and Endangered Species: The Delmarva Wildlife Work Group collected available rare and endangered species data and compiled it as a reference which is partially displayed in map form. The mapping effort was to delineate known locations of the Delmarva fox squirrel (Sciurus niger cinereus), bald eagle (Haliaetus leucocephalus), tiger salamander (Ambystoma tigrinum tirinum) and due to special interest, the carpenter frog (Rana virgatipes). See the wildlife display maps in Appendix A for location by major river basins. Additional rare and endangered species for which the status is uncertain include the red cockaded woodpecker (Dendrocopos borealis), and the narrow mouth toad (Gastrophryne carolinensis). The peregrine falcon (Falco peregrinus) habitat is basically contained along the coast. Work on this species is pro-

Wetland and cropland intermixing creates ideal habitat.

ceeding with a reintroduction program including the establishment of hacking stations.[15] The ipswich sparrow is rare and winters in the coastal dunes of the study area. Some of the ipswich sparrow's habitat is secure but additional habitat areas are being destroyed largely by recreational development. The main reason for its decline is loss of breeding habitat which occurs outside the study area.

The status of the Delmarva fox squirrel (Sciurus niger) can be summarized by viewing wildlife display maps. Active programs are being coordinated through development and implementation of a recovery plan. The prime objective of the plan is to restore the squirrel throughout its historic range from southern New Jersey and southeastern Pennsylvania down through the Delmarva Peninsula. Programs including trapping and relocation, habitat research, and the establishment of over 2,500 nest boxes head the list of restoration activities. The Delmarva River Basins habitat inventory is being applied to locate additional habitat areas where the squirrel probably would reestablish. This habitat location is being coordinated in conjunction with the University of Maryland's research activities.

The Smithsonian Institution has complied with the requirements of the 1973 Endangered Species Act by preparing a list of 3,187 candidate endangered and threatened plant taxa. The list was accepted by the U.S. Fish and Wildlife Service as a petition in The Federal Register on July 1, 1975. The most important difference between plants and animals in the act is that the "taking" of endangered animals is prohibited; whereas, the taking of endangered plants is not. Consequently people with knowledge of a rare plant or a unique vegetative community will not disclose the location for fear of desecration.

Recreation Resources

The demand for recreation is escalating faster than the Delmarva's population growth. Both the public and private sectors have recognized the need for suitable recreational facilities to meet the demands of increasing leisure time. In the public sector, the state park system is the most important source of recreation. Local governments, churches, schools, industries and private interest groups provide playgrounds, parks, picnic areas and cultural meeting places. The private sector also provides important facilities such as golf courses, motels, fishing piers and fishing boats. One of the latest trends is a combination of private and public facilities in the same area.

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15 Hacking station - a feeding rack and station to keep hawks in partial liberty.

There was no effort by this study to inventory or project recreation demand or supply for the Delmarva Peninsula. State and local planning institutions are responsible for recognizing such needs and implementing project action. The Maryland Outdoor Recreation and Open Space Plan, the Virginia Outdoors Plan and the Delaware Comprehensive Outdoor Recreation Plan identifies recreation facilities and land needs.

Archaeological, Historical and Unique Scenic Resources

Paleo-Indians utilized the wild game resources of the Delmarva Peninsula over 10,000 years ago. Later the Archaic culture established hunting camps along the major rivers and coastal areas. From 2,500 to 3,000 years ago Indians of the Woodland Culture began to succeed them. The Woodland Cultures cultivated corn, beans, squash and other plants, and had more sedentary settlement patterns than their predecessors. The historic Nanticoke, Choptank, Assateague, Pocomoke, and Delaware Indians, who occupied the Peninsula when the first white man arrived, are related to the later phases of the Woodland Cultures.[16]

Although settlement in the tidewater regions of the Delmarva Peninsula began in the early seventeenth century, the early colonists did not penetrate deeply into the marshy and wooded interior. Later in the nineteenth century, settlement spread throughout the Peninsula with agriculture as the dominant activity. A few towns, developed at crossroads, provided services to the rural communities. Local architecture tended to utilitarian styles in both homesteads and community centers. Most sites of historic and architectural significance are farm houses of the early nineteenth century.

It is evident from early history that archaeological and historical resources are significant throughout the Peninsula. Should any of these resources be discovered from any project activity the recovery, protection, or preservation operations will be handled in accordance with the Archaeological and Historical Preservation Act (PL 93-291).

Economic Development

Historical Development

Geographically, the rural agricultural section of the Peninsula

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16 Thomas, R. A., 1974, "A Brief Survey of Prehistoric Man on the Delmarva Peninsula," Section of Archeology of the State of Delaware.

was separated by water from the northern urban section and bypassed when the great westward flow of immigration occurred during the 1800's. For three hundred years the Peninsula was relatively isolated. Access from the mainland and from the large population centers was by ferry or by secondary roads from the North. Construction of the Bay Bridge connecting Annapolis with Queen Annes County, Maryland, in 1952 (and a parallel span completed in 1972) provided a major east-west link between the Baltimore - Washington urban complex and the Delmarva Peninsula. In 1964 construction was completed on the Chesapeake Bay Bridge-Tunnel, a major north-south artery connecting the Norfolk - Portsmouth metropolitan area with Northampton County, Virginia on the southern tip of the Peninsula. The bridge-tunnel, which transverses the Chesapeake Bay for twenty-one miles, is the longest bridge-tunnel in the world. For more detail of the Peninsula history see Appendix B, Socio-Economic Base Report.

Transportation

The major transportation system within the Delmarva Peninsula is Highway U.S. 301. This is a dual highway and a north-south through route extending from the New Jersey Turnpike across the Chesapeake Bay Bridge and thence southward to Florida. The Bay Bridge connects the Peninsula with the mainland at Annapolis, Maryland forming an important link in the Peninsula's transportation system. Another dual Highway, U.S. 50, serves as the principal Maryland gateway to the Peninsula in addition to being an important connector between the Peninsula and Washington, D.C. and major interstate highways to the west and south.

Highway U.S. 13 is the major north-south divided highway that offers a rapid route from Wilmington south to the Bay Bridge-Tunnel. Since the construction of the Bay Bridge-Tunnel, the Peninsula serves as a transportation corridor between Wilmington, Norfolk and points south and west. Several trucking lines serve the area and provide twenty-four hour service within a three hundred mile radius that encompasses the Boston to Washington, D.C. megalopolis.

In April of 1976 Conrail (Consolidated Rail Corporation) was created as part of a national reorganization of the railroad system in the Northeastern United States. Conrail, under the auspices of the Federal Government, acquired several sections of former Penn Central Railroad track and in 1978 operated two main freight, but no passenger, lines on the Delmarva Peninsula. One line provides north-south service from Wilmington through Salisbury, to Pocomoke City in southwestern Worcester County. The other major trunk line extends east from Harrington, in southwestern Kent County, Delaware then south to Snow Hill in central Worcester County, Maryland. An additional rail line not owned by Conrail is found on the Virginia portion of the Peninsula.

National and international air passenger and freight service is available in major metropolitan areas adjacent to the Peninsula at airports in Norfolk, Baltimore, and Wilmington. On the Peninsula, airports at Dover and Salisbury provide area residents and businesses with regional and commuter air service within the northeastern corridor while numerous small airstrips provide charter service and private aviation facilities. The major bus companies such as Trailways and Greyhound serve the region with terminals located in the larger population centers.

The Peninsula is surrounded by several major waterways: the Delaware River, the Chesapeake and Delaware Canal, Chesapeake Bay, and Atlantic Ocean. The C&D Canal is a transportation link between Philadelphia and Baltimore. The canal is used by large ocean going vessels because it shortens the route from Baltimore to Philadelphia by 316 miles, to New York by 179 miles, and to European ports by about 100 miles.

Commerce through the C&D Canal is dominated by domestic movements of bulk oil and foreign movements of general cargo which together accounted for approximately 70 percent of total traffic in 1972. In addition to bulk oil and general cargo, there are significantly smaller quantities of coal, ore, grain, and miscellaneous bulk commodities passing through the C&D Canal. During the 1965-1972 period an average of about 1.1 million short tons of cargo was transported through the canal annually. The potential exists for a substantial increase in tonnage if a significant number of Northeastern power plants convert from oil to coal. In 1977, the depth of the C&D Canal was increased from 27 to 35 feet.

Interrelationships of Water and Land Resources

Interrelationships between the use of water and land are complex. Development of land for agricultural, commercial, or residential use may require engineering measures for drainage or flood protection purposes and concurrent water resource development to provide adequate water supplies for municipal purposes or for irrigation. Additionally, the quantity and quality of water is influenced by the use of land in that urban and industrial growth are frequently associated with flooding, water pollution, and sedimentation. The increasing demand for land, which affects water use in turn, is clearly expressed by Marion Clawson: ".... as total population grows, more land will be required for site purpose.... for primary homes, for second homes, for shopping centers, for offices, etc. As incomes rise and as leisure increases, more land will be used for recreation either as the sole use or as one of several uses. More people will require more food .... and

higher outputs per acre may meet most or all of the increased volume of food commodities required by more people." [17]

The use of water and related land resources is linked with population, income, and employment growth. Increasing numbers of persons with higher incomes and more jobs will cause more intensive use of water and related land. Consequently, growth will affect the future availability and cost of these finite resources. Effective resource management and planning for the area should provide for regional growth and prosperity while maintaining and protecting the unique environment that exists on the Delmarva Peninsula.

Population Characteristics

The general parameters of population and income supplemented by indicators of the age distribution of the population, educational levels achieved, the composition of the labor force, unemployment, population density, income distribution and poverty, and housing conditions are covered in detail in Appendix B.

Table II-G shows the number of persons residing on the Peninsula in 1970 (the date of the most recent official census survey) was 849,868. This total represented an increase of 270,028 (or 46.6 percent) over the 1950 population. The national population grew approximately thirty-three percent over the same twenty year period, considerably less than the Peninsula growth.

According to the Bureau of Census population estimates and projections, the number of persons residing within the confines of the Delmarva Peninsula in 1976 was 907,200. During the six year period between 1970 and 1976 the population was estimated to have increased by 57,332 or 6.7 percent. Over the twenty-six year period between 1950 and 1976 the Peninsula experienced an increase of 327,360 (or 56.5 percent) in population.

Table II-H also presents data on the rural population of the Peninsula and its farm and non-farm components. The growth of the Peninsula population and of the rural and rural non-farm population is also illustrated in Figure II-3. In 1970, 47.1 percent of the Peninsula population was classified as "rural" and 3.7 percent was "rural farm." In 1950, these statistics were 57.3 percent and 17.0 percent respectively.

The Peninsula totals shown, however, are not entirely representative of the area south of the C&D Canal due to the inclusion of data for Cecil County, Maryland, and New Castle County, Delaware. In both

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17 Marion Clawson, National Land Use Policy (New York, 1971), p. 31.

Table II-G - Total population (1950, 1960, and 1970, plus 1976 projections) and rural population (1950, 1960, and 1970), Delmarva Peninsula.

Subarea	Total population				Rural population			Percent rural		
	1950	1960	1970	1976 [1]	1950	1960	1970	1950	1960	1970
Delmarva Peninsula	579,840	737,463	849,868	907,200	332,299	393,337	400,319	57.3	53.3	47.1
Delaware	318,085	446,292	548,093	582,100	118,863	153,504	152,943	37.4	34.4	27.9
Kent	37,870	65,651	81,892	91,900	29,393	52,912	50,269	77.6	80.6	61.4
New Castle	218,879	307,446	385,851	401,200	39,850	41,108	33,771	18.2	13.4	8.8
Sussex	61,336	73,195	80,350	89,000	49,620	59,484	68,903	80.9	81.3	85.8
Maryland	210,623	243,570	258,329	278,800	165,028	192,232	203,930	78.3	78.9	78.9
Upper Shore	99,274	121,498	131,322	141,400	86,050	105,570	110,418	86.7	86.9	84.1
Caroline	18,234	19,462	19,781	22,100	18,234	19,462	19,781	100.0	100.0	100.0
Cecil	33,356	48,408	53,291	55,100	28,111	42,419	42,672	84.3	87.6	80.1
Kent	13,677	15,481	16,146	16,900	10,534	11,879	12,670	77.0	76.7	78.5
Queen Annes	14,579	16,569	18,422	21,600	14,579	16,569	18,422	100.0	100.0	100.0
Talbot	19,428	21,578	23,682	25,700	14,592	15,241	16,873	75.1	70.6	71.2
Lower Shore	111,349	122,072	127,007	137,400	78,978	86,662	93,512	70.9	71.0	73.6
Dorchester	27,815	29,666	29,405	30,100	17,464	17,427	17,810	62.8	58.7	60.6
Somerset	20,745	19,623	18,924	20,000	17,057	16,083	15,849	82.2	82.0	83.8
Wicomico	39,641	49,050	54,236	60,500	24,500	32,748	38,984	61.8	66.8	71.9
Worcester	23,148	23,733	24,442	26,800	19,957	20,404	20,869	86.2	86.0	85.4
irginia	51,132	47,601	43,446	46,300	48,408	47,601	43,446	94.7	100.0	100.0
Accomack	33,832	30,635	29,004	30,900	31,108	30,635	29,004	91.9	100.0	100.0
Northampton	17,300	16,966	14,442	15,400	17,300	16,966	14,442	100.0	100.0	100.0

1 1976 figures derived from current Population Reports (Series P-26) September, 1977. Issued by United States Department of Commerce, Bureau of the Census.

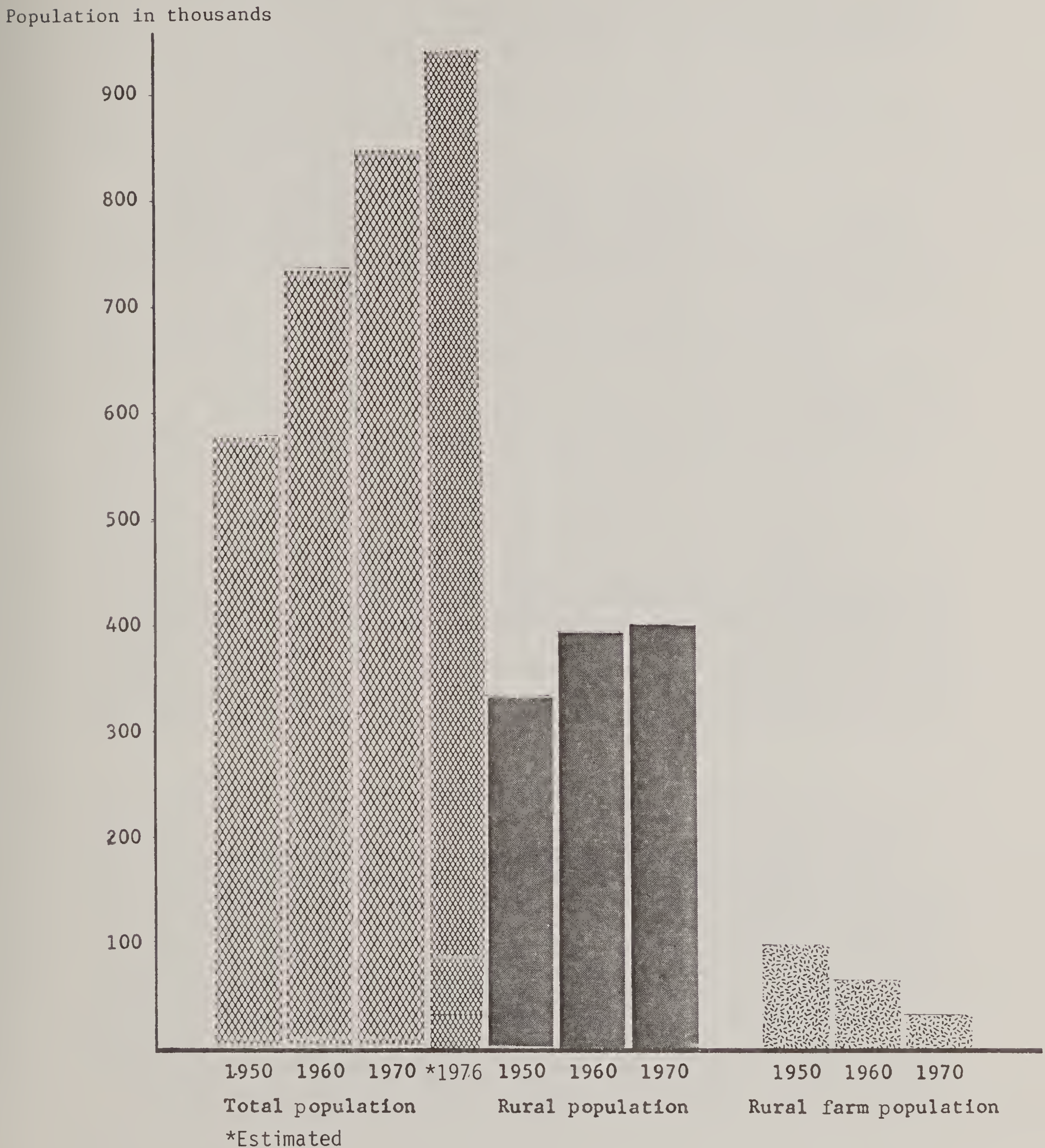
Table II-H - Rural population, Delmarva Peninsula, 1950, 1960, and 1970.

Subarea	Rural nonfarm population			Rural farm population			Percent rural farm [1]		
	1950	1960	1970	1950	1960	1970	1950	1960	1970
Delmarva Peninsula	233,983	332,298	368,908	98,316	61,039	31,411	17.0	8.3	3.7
Delaware	84,638	131,683	141,583	34,225	21,821	11,360	10.8	4.9	2.1
Kent	18,989	46,165	46,517	10,404	6,294	3,752	27.5	9.6	4.6
New Castle	33,447	37,386	31,731	6,403	3,722	2,040	2.9	1.2	0.5
Sussex	32,202	47,679	63,335	17,418	11,805	5,568	28.4	16.1	6.9
Maryland	115,049	160,473	185,983	49,979	31,759	17,947	23.7	13.0	6.9
Upper Shore	60,170	88,198	100,248	25,880	17,372	10,170	26.1	14.3	7.7
Caroline	11,546	15,078	17,406	6,688	4,384	2,375	36.7	22.5	12.0
Cecil	21,655	38,882	40,180	6,456	3,537	2,492	19.4	7.3	4.7
Kent	7,501	9,095	11,031	3,033	2,784	1,639	22.2	18.0	10.2
Queen Annes	9,406	12,832	16,765	5,173	3,737	1,657	35.5	22.6	9.0
Talbot	10,062	12,311	14,866	4,530	2,930	2,007	23.3	13.6	8.5
Lower Shore	54,879	72,275	85,735	24,099	14,387	7,777	21.6	11.8	6.1
Dorchester	11,920	14,277	16,225	5,544	3,150	1,585	19.9	10.6	5.4
Somerset	12,922	13,454	14,341	4,135	2,629	1,508	19.9	13.4	8.0
Wicomico	17,052	28,307	36,523	7,448	4,441	2,461	18.8	9.1	4.5
Worcester	12,985	16,237	18,646	6,972	4,167	2,223	30.1	17.6	9.1
Virginia	34,296	40,142	41,342	14,112	7,459	2,104	27.6	15.7	4.8
Accomack	22,485	26,035	27,995	8,623	4,600	1,009	25.5	15.0	3.5
Northampton	11,811	14,107	13,347	5,489	2,859	1,095	31.7	16.9	7.6

1 As a percent of total population.

Source: Bureau of the Census, Census of Population 1950, 1960, and 1970.

Figure II-3 - Delmarva population trends: 1950-1970 and 1976.



counties, the majority of the population resides north of the canal and thus, outside the survey area. If these two counties are not included in the Peninsula totals, the population growth and the rural population statistics are markedly different:

Area	Population growth 1950—1970	Percent rural 1950	Percent rural 1970	Population growth 1970—1976	Population growth 1950—1976
Delmarva Peninsula (14 counties)	46.6%	57.3	47.1	6.7%	56.5%
Delmarva Peninsula (excluding Cecil and New Castle Counties)	25.4%	80.7	78.9	1.5%	31.6%

Accordingly, one can conclude that the population of the survey area grew at a considerably slower rate than the national population over the same period and that it remained overwhelmingly rural. These conclusions are confirmed by an examination of the county data in Table II-G. Between 1950 and 1970, three counties (Accomack and Northampton, Virginia, and Somerset, Maryland) actually lost population and an additional three counties gained less than 10 percent. Of the counties wholly in the survey area, only Kent County, Delaware, grew faster than the national rate.

General Economy

Data for the period 1950 through 1970 suggests that the Delmarva Peninsula continued to experience a transition from an essentially agrarian economy to a modern mixed economy based on manufacturing and services in addition to agriculture. It should be noted, however, that this phase of economic growth did not begin on the Peninsula until recently. Early industrial growth in the Middle Atlantic region occurred in proximity to sources of power and raw materials. The Peninsula, like the Coastal Plain in general, lacked the topography necessary for water power and had no deposits of coal or important minerals. It did, however, have the soils and temperate climate that encouraged intensive agricultural development. Similarly, abundant forest resources supported the development of a forestry sector and the surrounding waters yielded

large harvests of shellfish, crabs, and finfish. The location of the Peninsula with respect to major urban markets was also propitious. With the advent of railroads and, later, highway systems, transportation of the Peninsula's products shifted from ships and barges to the land modes. Because of its geography, however, the Peninsula was still relatively isolated and this discouraged the development of a diversified manufacturing sector. Typical of most agricultural areas, the Peninsula during this period had a labor surplus. Some of this surplus was absorbed by labor-intensive manufacturing enterprises such as clothing and apparel, but the remainder left the Peninsula in search of superior employment opportunities.

Completion of the Chesapeake Bay Bridge in 1952 marked a significant turning point in the Peninsula's economic development. The Bridge represented a major improvement in the Peninsula's accessibility with respect to the Baltimore, Maryland - Washington, D.C. metropolitan areas and states to the east and south. The economic impact was two-fold. First, industrial development was stimulated by removal of the impediment to east-west travel posed by the Bay (despite ferry service). Second, the Bridge provided ready access to the Eastern Shore and the Atlantic beaches for residents of the Baltimore - Washington area. The Peninsula had historically been a popular area for summer recreation, but the increased demand for recreation created by rising incomes and increased leisure time was a powerful stimulus for further recreational development of the resources of the Peninsula once the Bridge became available for use. The opening of the Bridge-Tunnel at the mouth of the Bay in 1965 further improved accessibility -- particularly into the southern half of the Peninsula.

Along with the transportation improvements made since the 1950's, other forces and events acted to transform the Delmarva economy (see Appendix B).

Employment

Insight into the changes that occurred in the economy of the Peninsula between 1950 and 1970 is provided by an examination of employment trends among and within industry sectors over time. Peninsula employment by industry sector for 1950 and 1970 is shown in Table II-I. Also shown in Table II-I are the absolute and percentage changes in employment by industry between 1950 and 1970 and the present distribution of total employment over industry sectors in each year. Total employment in the twelve counties below the canal increased by 33,562 (or 25.7 percent) over the 1950-70 period. This was essentially the same as the relative increase in population of 25.4 percent. The increase in total employment implies that there was an average annual growth rate of only 1.2 percent. Within industrial sectors, changes in employment over the period varied much more widely than total employment.

Table II-I - Employment by industry sector, 1950 and 1970, and change in industry employment, 1950-1970, Delmarva Peninsula.

Industry	1950		1970		Change 1950--1970	
	Number	Percent of total	Number	Percent of total	Number	Percent
Agriculture, forestry, and fisheries	35,363	27.1	15,159	9.2	-20,204	-57.1
Mining	63	*	140	0.1	77	122.2
Contract construction	9,375	7.2	13,393	8.2	4,018	42.9
Manufacturing	28,838	22.2	40,515	24.7	11,677	40.5
Food and kindred products mfg.	10,109	7.8	15,038	9.2	4,929	48.8
Textile and apparel products mfg.	5,100	3.9	7,042	4.3	1,942	38.1
Lumber, wood products, furniture mfg.	5,035	3.9	1,470	0.9	-3,565	-70.8
Printing and publishing	605	0.5	2,345	1.4	1,740	287.6
Chemicals and allied products mfg.	2,794	2.1	4,040	2.5	1,246	44.6
Electrical and other machinery mfg.	520	0.4	2,881	1.8	2,361	454.0
Motor vehicles and equipment mfg.	496	0.4	1,213	0.7	717	144.6
Other and miscellaneous mfg.	4,179	3.2	6,486	3.9	2,307	55.2
Transportation, communications, and utilities	7,048	5.4	8,584	5.2	1,536	21.8
Railroads and railway express	1,182	0.9	361	0.2	-821	-69.5
Trucking and warehousing	2,097	1.6	2,481	1.5	384	18.3
Other transportation	1,482	1.1	1,658	1.0	176	11.9
Communications	1,037	0.8	1,712	1.0	675	65.1
Utilities and sanitary service	1,250	1.0	2,372	1.5	1,122	89.8
Wholesale and retail trade	20,855	16.0	31,143	19.0	10,288	49.3
Wholesale trade	4,500	3.4	6,229	3.8	1,729	38.4
Food and dairy products stores	3,891	3.0	4,122	2.5	231	5.9
Eating and drinking places	2,428	1.9	3,610	2.2	1,182	48.9
Other retail trade	10,036	7.7	17,182	10.5	7,146	71.2

Table II-I - Employment by industry sector, 1950 and 1970, and change in industry employment, 1950-1970, Delmarva Peninsula.

Industry	1950		1970		Change 1950—1970	
	Number	Percent of total	Number	Percent of total	Number	Percent
Finance, insurance and real estate	2,266	1.7	4,526	2.8	2,260	99.7
Services	18,868	14.5	35,601	21.7	16,733	88.7
Hotels and other personal services	3,329	2.6	5,072	3.1	1,743	52.4
Private households	5,156	4.0	3,843	2.3	-1,313	-25.5
Business and repair services	2,926	2.2	2,939	1.8	13	0.4
Entertainment, recreation services	679	0.5	1,192	0.7	513	75.6
Medical, other professional services	6,778	5.2	22,555	13.8	15,777	232.8
Public administration	3,622	2.8	8,416	5.1	4,794	132.4
Armed Forces	1,735	1.3	6,481	4.0	4,746	273.5
Industry not reported	2,363	1.8	0	0.0	0	0.0
Delmarva Peninsula Total	130,396	100.0	163,958	100.0	33,562	25.7

Source: Growth Patterns in Employment by County, 1940-1950 and 1950-1960, Vol. 2., U.S. Department of Commerce/ Office of Business Economics (Washington, D.C., 1965). Bureau of the Census, 1970 Census of Population.

* Less than 0.1 percent.

A closer examination of the data in Table II-H reveals industry growth rates ranged from -70.8 percent to 454.0 percent. Trends in major sectors are outlined in Appendix B.

Agriculture

Despite an appreciable decrease in farm employment and its share of earnings since 1950, the agricultural sector continues to provide a substantial number of employment and income opportunities. Agriculture still remains the major economic force within the Delmarva Peninsula, supporting an agri-business complex that includes hatcheries, feed mills, and processing plants of integrated broiler firms; vegetable canning and freezing plants; and suppliers of machinery, fertilizer, and other farm inputs. Numerous individuals are employed and receive income directly from agriculture and allied industries for performing tasks primarily associated with producing, harvesting, and marketing farm and farm-related products. In addition, the agricultural sector indirectly generates other employment and income opportunities. Many individuals are employed by and receive income from business concerns which supply the non-farm goods and services demanded by the agricultural sector. The total amount of jobs and earnings that can be directly or indirectly attributed to agriculture and related industries is substantial and only partly indicated by statistics of the agricultural sector. The continuing viability of Delmarva agriculture contrasts sharply with other parts of the Northeast where agriculture has been displaced by residential and commercial development and by changes in national production patterns. As the following data indicates, Delmarva agriculture has been subjected to similar pressures.

Because the portions of Cecil and New Castle Counties that are part of the survey area are primarily agricultural, data for these two counties as a whole have been included in the analysis. In addition, data for the Upper and Lower Shore areas of Maryland are presented separately to reflect the differences in climate, soils, and type of farming that distinguish the two areas.

Farm Characteristics

Following national trends, the Peninsula experienced a moderate decrease in the acreage of land in farms (Table II-J). The average size reportable farm over the same period increased by 35 percent from 156.7 acres in 1959 to 212 acres in 1974. The decline in the number of farms reported was relatively uniform over the counties of the survey area and was the result of the adoption of labor-saving technology with its accompanying increase in the size of optimal management units, the availability of off-farm employment opportunities, and changes in the definitions of reportable farms. The acreage of land in farms

Table II-J - Number of farms, land in farms, and average size of farm, Delmarva Peninsula, 1959, 1964, 1969, and 1974.

Subarea	Number of farms [1]				Land in farms [1]				Average size of farm			
	1959	1964	1969	1974	1959	1964	1969	1974	1959	1964	1969	1974
					Acres				Acres			
Delmarva Peninsula	14,220	11,605	10,041	8,876	2,228,790	2,097,216	1,970,755	1,880,426	156.7	180.7	196.3	212
Delaware	5,208	4,401	3,710	3,400	762,526	717,015	673,895	630,605	146.4	162.9	181.6	185
Kent	1,533	1,219	1,073	976	251,834	232,125	219,788	196,410	164.3	190.4	204.8	201
New Castle	739	564	516	432	129,650	121,055	113,251	100,172	175.4	214.6	219.4	232
Sussex	2,936	2,618	2,121	1,992	380,942	363,835	340,856	334,023	129.7	139.0	160.7	168
Maryland	7,837	6,199	5,624	4,826	1,287,007	1,205,970	1,140,669	1,095,429	164.2	194.5	202.8	227
Upper Shore	3,929	3,125	2,816	2,443	766,219	721,064	690,655	652,212	195.0	230.7	245.3	267
Caroline	1,177	923	817	740	156,771	144,855	132,782	128,788	133.2	156.9	162.5	174
Cecil	832	659	541	480	138,649	127,455	113,710	99,158	166.6	193.4	210.1	207
Kent	538	470	488	352	149,968	145,865	148,420	137,458	278.8	310.4	304.1	391
Queen Annes	812	641	551	497	182,772	177,695	170,589	166,087	225.1	277.2	309.5	334
Talbot	570	432	419	374	133,059	125,195	125,154	120,721	242.2	289.8	298.6	323
Lower Shore	3,908	3,074	2,808	2,383	520,788	484,905	450,014	443,217	133.3	157.7	160.3	186
Dorchester	729	616	516	456	157,050	150,065	139,583	147,302	215.4	243.6	270.5	323
Somerset	663	573	470	435	85,528	78,610	69,744	69,618	129.0	137.2	148.3	160
Wicomico	1,418	1,061	1,037	851	131,363	116,475	112,545	102,523	92.6	109.8	108.5	120
Worcester	1,098	824	785	641	146,847	139,755	128,142	123,774	133.7	169.6	163.2	193
Virginia	1,175	1,005	707	650	179,257	174,231	156,191	154,392	152.6	173.4	220.9	238
Accomack	805	690	466	420	112,191	114,185	105,031	96,708	139.4	165.5	225.3	230
Northampton	370	315	241	230	67,066	60,046	51,160	57,684	181.3	203.3	212.2	251

1 See Census definition of land in farms for 1959, 1964, 1969, and 1974.

Source: Bureau of Census, Census of Agriculture, 1959, 1964, 1969, and 1974.

decreased for two distinct but related reasons. Land will be used for agricultural purposes only when returns to land in agriculture exceed its return for competing uses. Some land in farms on the Peninsula was lost to residential, commercial, and industrial development despite its relatively high agricultural value. The remaining decrease in farm acreage resulted from changes in agricultural values that led to either outright abandonment or a change to less intensive use.

The average size farm in 1974 varied considerably among Peninsula counties ranging between 120 acres in Wicomico County, Maryland, to 391 acres in Kent County, Maryland. Farms in the Upper Shore area of Maryland were of a considerably larger average size than those of the Lower Shore. In three counties on the Lower Shore of Maryland the average size of farms was greater than 320 acres. The greatest change in average size between 1959 and 1974 occurred in Accomack County, Virginia, where a 48 percent decrease in farm numbers and only a 14 percent decrease in land in farms resulted in a 65 percent increase in the average farm size. Figure II-4 further illustrates Peninsula trends in number of farms, land in farms, and average size of farm.

The statistics presented in Table II-A on type of farm indicate the changes in Delmarva agriculture that occurred between 1959 and 1974 and the distribution of farm types across Peninsula subareas. In 1959, the predominant farm types were poultry, cash-grain, dairy, and general farms, in that order, with distinct differences among the subareas in the distribution of these types. In the Delaware subarea, poultry farms were the predominant farm type followed by cash-grain and dairy farms. In the Upper Shore subarea, dairy farms predominated with cash-grain and poultry farms being secondary specialties. On the Lower Shore poultry and cash-grain farms predominated. Interestingly, there were only 10 dairy farms in the Virginia subarea in 1959 and only slightly more than 100 in the Lower Shore subarea of Maryland.

By 1974, cash-grain farms had become the most numerous type of farm on the Peninsula followed closely by poultry farms. In 1959, these two types comprised 40.5 percent of all Delmarva farms, but by 1974, had almost doubled, with 79.1 percent of all farms being devoted to either cash-grain or poultry production. The number of dairy and general farms on the Peninsula decreased by over half both in absolute and percentage terms. No dairy operations were reported in Virginia. Cash-grain and dairy farms continued to be most prevalent in the northern half of the Peninsula with poultry and cash-grain farms dominating in the southern half. Vegetable farms, while decreasing in absolute number on the Peninsula, actually increased in percentage in Delaware and Virginia. While cash-grain farms predominate, 12.1 percent of all farms in Virginia are devoted to vegetable production. See Table 16, Appendix B, which reflects corresponding sales of farm products.

The tenure of farm operators in 1974 is illustrated in Figure II-5. For the Peninsula as a whole, 59.4 percent of all operators were full owners, 28.2 percent were part owners, and 12.4 percent were

Figure II-4 - Delmarva farm trends - 1959-1974.

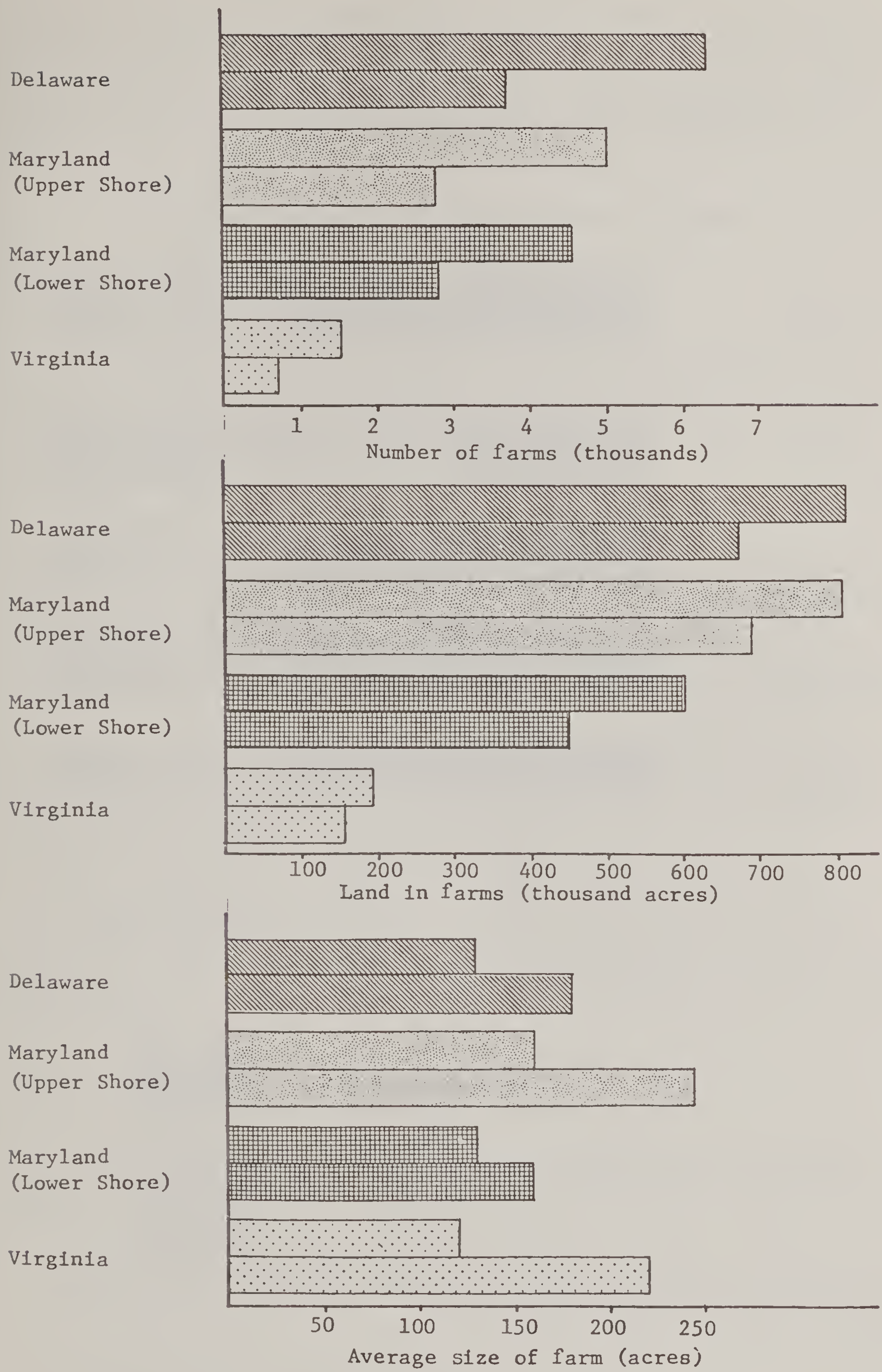
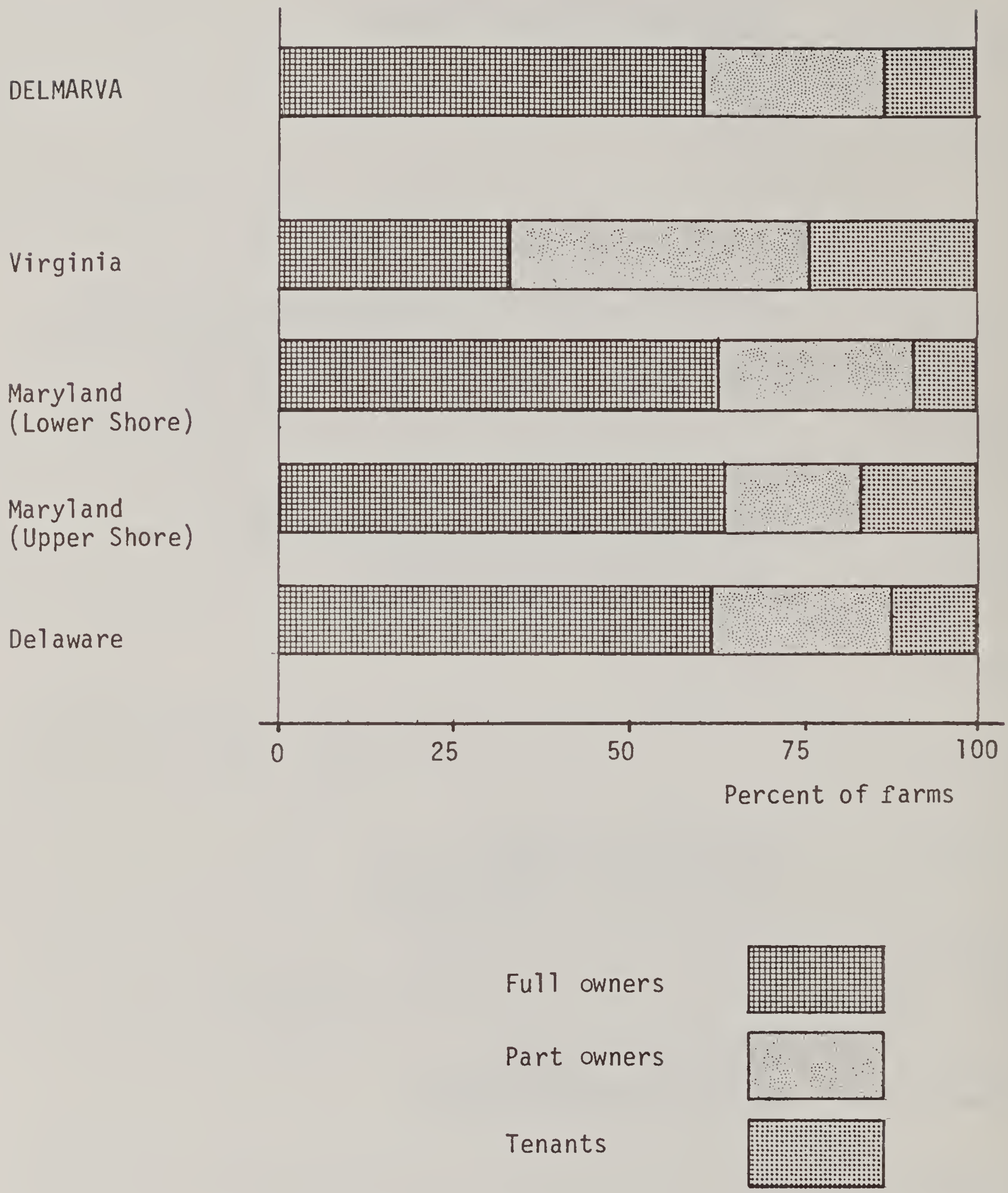


Figure II-5 - Delmarva farm tenure 1974.



Source: Census of Agriculture.

tenants. Subareas exhibited little variation in tenure pattern with the exception of the Virginia subarea where full owners comprised only 38.5 percent of all farm operators with part owners and tenants a more common form of tenure than in the remainder of the Peninsula. A complete profile of the Peninsula's agriculture industry can be found in Appendix B.

Forest Resources and Related Economic Activity

General Description

The forested areas of the Delmarva Peninsula are scattered fairly uniformly throughout the basins, with the hardwood types in the northern portion gradually merging with and changing to the pine types in the southern sector. Hardwood types account for about 52 percent of the forest acreage, softwood types for 48 percent.

According to periodic resurveys made by the U.S. Forest Service in cooperation with Maryland, Delaware and Virginia, the overall quality of the timber grown in the forests of the Delmarva Peninsula has been declining for years. This quality decline is caused by poor management and inferior logging practices which have left the timber stands poorly stocked with trees of low economic value. Over-cutting in the softwood stands has reduced the available sawtimber supply and annual growth of residual stands has been less than the volume cut.

The most prevalent forest types occurring on the Peninsula are loblolly-shortleaf pine, oak-hickory, oak-pine, oak-gum, and red maple. These types cover about 99 percent of the forest land. The pine and mixed oak-pine types make up nearly 50 percent of the forest land with the balance in hardwoods, principally oaks.

The ownership of the Peninsula's forest land is approximately 5,000 acres (0.4 percent) federally owned; 31,300 acres (2.5 percent) state owned; and the remaining 1,221,600 (97.1 percent) in private ownership. Farmers hold 1,132,500 acres or 90 percent of private ownership with the forest industry accounting for 7 percent or approximately 89,100 acres.

Kinds, Volume and Value of Forestry Output

Timber production on the Eastern Shore centers mainly on sawlogs, veneer logs, piling, poles, and pulpwood, with some minor production of barrel staves.

Forest stands capable of growing the above wood products are

classified as growing stock and sawtimber. Growing stock is more representative of the whole forest as it includes all the sawtimber trees, the pole size timber, and the seedlings and saplings. Sawtimber includes only those trees large enough to be harvestable as sawlogs or veneer logs. The following table gives the volume of growing stock and sawtimber for the three states of the Delmarva Peninsula.

Table II-K - Volume of growing stock and sawtimber by state, Delmarva Peninsula (1975).

	Growing stock [1] million cubic feet	Sawtimber million cubic feet
Delaware	622.7	271.3
Maryland	932.5	411.6
Virginia	220.4	72.3
Total	1,775.6	755.2

1 Includes seedling and sapling stands.

Source: USFS-Timber Resources of Delaware, Maryland and Virginia 1966 - 1974.

Growing stock is the net volume, in cubic feet, of sawtimber and poletimber trees from stump to a minimum four-inch top outside bark. Net volume equals gross volume less deduction for rot. Sawtimber volume on Table II-K represents all sawboard volume of all stand components. The fact that this volume represents only 42 percent of the total wood volume (growing stock) is an indication of underutilization of the growing space. There is an inadequate number of larger sawtimber size trees in the forests. As the forest is managed, the sawtimber components will increase in average size (and volume) per tree bringing the percent of sawlog (sawtimber) cubic footage closer to the percentage of land in sawtimber size forest stands.

The present volume of growing stock on commercial forest land is 1,775.6 million cubic feet. Total sawtimber volume is about 755 million cubic feet, an average of 549 cubic feet per acre. Of the forest land 62 percent is in sawtimber stands, 22 percent in pole stands, and 16

percent in seedling-sapling stands.

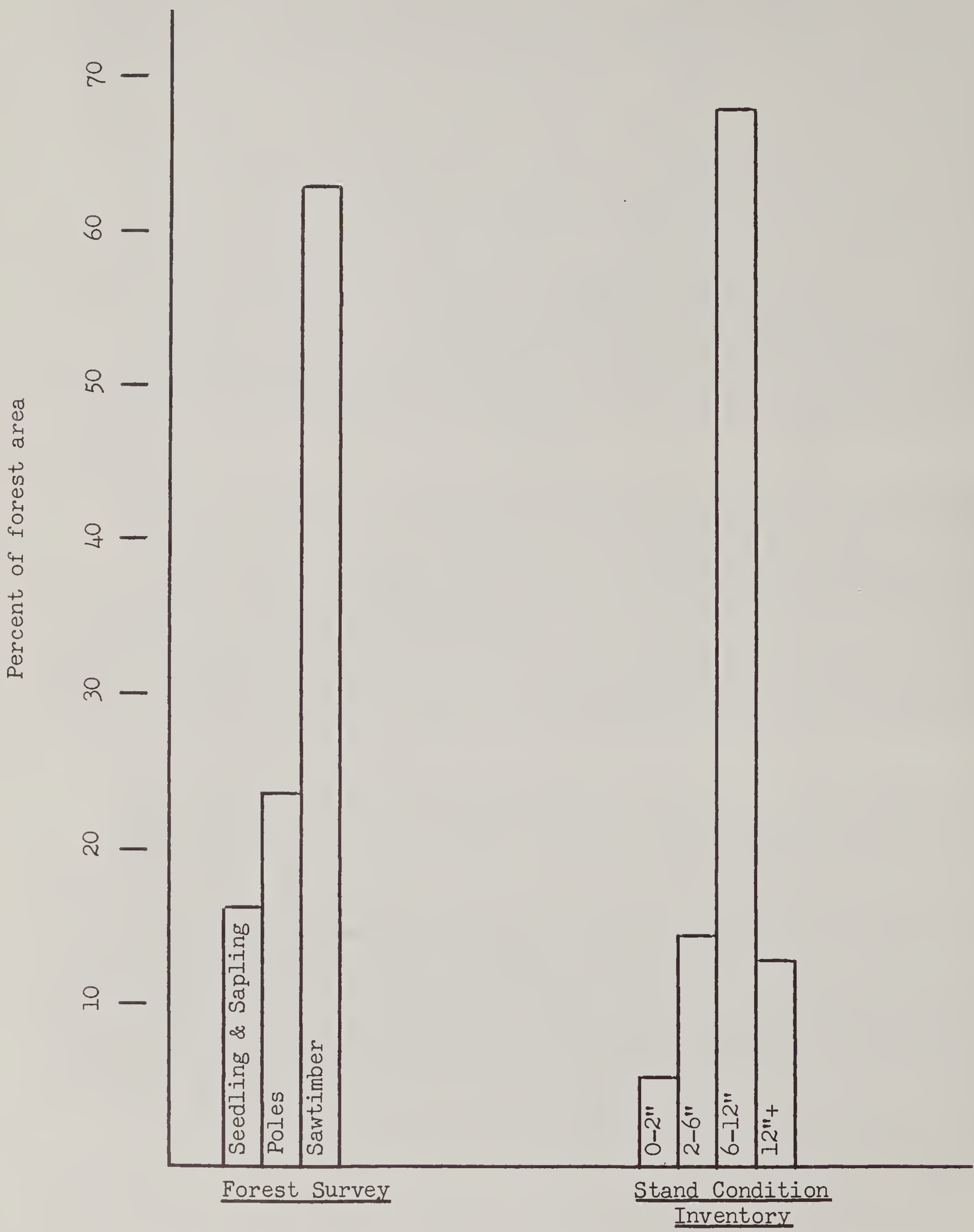
Hardwood species account for 57 percent of the sawlog and pole-timber volume, while softwoods make up the other 43 percent. To better describe the forest stands on the Peninsula, data on timber types and size classes from the land use and management condition survey conducted on the Peninsula was used. The following Figure II-6 shows the percent of area of forest land broken in size classes according to Forest Survey and the above mentioned study. There were different increments used in making up the size classes, so figures only serve to display the same basic information two different ways. For example, Forest Survey defines sawtimber trees as trees of commercial species that: (1) are of the following minimum diameter at breast height - softwoods 9.0 inches and hardwoods 11.0 inches; and (2) contains at least one merchantable sawlog. The land use and management condition survey on the other hand categorized trees by 0"-2", 2"-6", 5"-12", and 12" plus diameter at breast height groups. Therefore, sawtimber size trees as defined by Forest Survey could occur in both the 6"-12" and 12" plus categories. This would indicate that a high percentage of the sawtimber as defined by Forest Survey occurs in the less than 12" diameter classes.

Markets: Recent severe winters have increased the demand for piling Fence posts and landscaping poles also currently constitute a viable market. There are indications that firewood could be a tremendous market within a short period of time. The majority of the roundwood chipped is used for production of pulp and roofing material. The demand for chips in landscaping is rising and could constitute an important market in the future. The recent installation of the Pittsville Wood Flour Plant in Maryland has increased the demand for sawmill by-products such as planer shavings, sawdust, etc. There is presently an increased interest in purchasing cross-tie material from the Peninsula.

As the disposal or utilization of sludge becomes more critical, the compositing of municipal or industrial sludge with hardwood chips or sawdust may be another possibility of increasing the future demand for low quality hardwoods.

The future outlook of market for low quality hardwoods on the Peninsula appears to be somewhat better than in previous years. There is no market data to support quantification of these trends in terms of cubic feet of material or dollar value at the present time. Support for the optimistic outlook comes from such things as increases in the sales of wood stoves on the Peninsula; studies by the State of Maryland and the Eastern Shore State Hospital to investigate the feasibility of partial conversion to wood energy (if installed, wood utilizing boiler systems would require a continuous amount of fuel in pelletized or ship form); and study observations of forestry professionals stationed throughout the Peninsula.

Figure II-6 - Stand size classes by Forest Survey and Stand Condition Inventory, Delmarva Peninsula.



Employment: Employment in the lumber and manufacturing industries on the basin dropped from 5,035 in 1950 to 1,662 in 1970, a 67 percent reduction in number of employees. Since 1970 there has been a small increase in the employment rate until in 1976 the work force was just over 2,000 employees. This would indicate that the employment level, while eratic by special areas, seems to be stabilizing to some extent. As the markets for forest products improve, there will be a corresponding improvement in forest related employment. This improvement is expected to be small and the total employment will remain well below the levels experienced in the 1950's.

CHAPTER III - INDICATIONS AND OBSERVATIONS FROM DELMARVA BASINS SPECIAL STUDIES

General

The Delmarva River Basins Survey objective to help resolve conflicts between fish and wildlife concerns and drainage projects led to the development of numerous studies. These studies have valuable data and inferences which pertain directly to making management decisions. This chapter presents some of the observations and indications which may aid in selecting the suggested alternative.

Relationship Between Channels, Hedgerows, and Wildlife

One of the most important associated values of channel construction to wildlife is hedgerow development. Cropland fields are becoming typified more by large continuous fields. In large fields where cropland productivity is enhanced through drainage measures and open channels the diversity, edge effect, and interspersion for most species are benefited when hedgerows are allowed to develop. Wildlife species use hedgerows as areas for nesting, feeding, breeding, resting, and as travelways. There are other environmental advantages of hedgerows if they are allowed to grow on the ditch berm and are properly managed. These advantages include protection from wind erosion, reservoir for predator insects, staging areas for birds of prey, thermal insulation of the water, reduction of soil erosion with associated nutrient and pesticide loads, and the landscaping scenic appeal. Economic advantages of hedgerows include the buffer capacity in slowing down the aggradation of sediments in streams and channels which otherwise requires additional maintenance, the protection of a farmer's investment from wind, and the possibility of developing an investment such as Christmas trees. The added revenue generated by selling hunting rights due to increased game availability would also be considered economically advantageous.

The economic cost and disadvantages of certain types of hedgerows are drainage obstruction, reservoirs of pest wildlife and insects, reduced mobility of machinery, and additional cost of maintaining ditches.

There are presently about 33,900 acres of hedgerows on the Delmarva Peninsula. Physical properties of these hedgerows are important in predicting use and value to wildlife. To determine the occurrences of the physical and location variables 5,317 hedgerows were randomly sampled. The types of hedgerows and their occurrence are displayed by variables in Table III-A.

Table III-A - Hedgerows displayed by variable combinations, less than 15 feet wide, Delmarva Peninsula.

(100) = %
5,317) = No.

Hedgerows	Along and/or in a ditch or waterway	Along a field, driveway, or fence property boundary (not a ditch)	Along a public road recorded only if over 40 percent woody	Along a woods	Along a public road and ditch recorded only if over 40 percent woody
Greater than 40 percent woody less than 15 feet high	(9) 493	(5) 275	(1) 49	(<1) 2	(<1) 5
Greater than 40 percent woody 15 to 30 feet high	(8) 401	(6) 332	(<1) 23	(<1) 5	(<1) 9
Greater than 40 percent woody over 30 feet high	(2) 118	(2) 100	(1) 51	(<1) 2	(<1) 2
Mainly herbaceous vegetation (less than 10 percent woody)	(23) 1,229	(4) 202	(<1) 4	(<1) 7	(<1) 24
Ten percent to 40 percent woody (seedling trees, brush and vines with herbaceous growth)	(4) 220	(3) 151	(<1) 5	(<1) 1	(<1) 2

Table III-A - Hedgerows displayed by variable combinations, 15 to 35 feet wide, Delmarva Peninsula.

(100) = %
5,317 = No.

Hedgerows	Along and/or in a ditch or waterway	Along a field, drive-way, or fence property boundary (not a ditch)	Along a public road recorded only if over 40 percent woody	Along a woods	Along a public road and ditch recorded only if over 40 percent woody
Greater than 40 percent woody less than 15 feet high	(2) 115	(1) 54	(<1) 5	(<1) 2	(<1) 3
Greater than 40 percent woody 15 to 30 feet high	(8) 434	(6) 299	(<1) 12	(<1) 4	(<1) 1
Greater than 40 percent woody over 30 feet high	(4) 210	(4) 239	(<1) 10	(<1) 1	(0) 0
Mainly herbaceous vegetation (less than 10 percent woody	(2) 132	(<1) 20	(<1) 2	(<1) 2	(<1) 2
Ten percent to 40 percent woody (seedling trees, brush and vines with herbaceous growth)	(1) 44	(1) 39	(0) 0	(<1) 3	(0) 0

Table III-A - Hedgerows displayed by variable combinations, 35 to 100 feet wide, Delmarva Peninsula.

(100) = %
5,317 = No.

Hedgerows	Along and/or in a ditch or waterway	Along a field, driveway, or fence property boundary (not a ditch)	Along a public road recorded only if over 40 percent woody	Along a woods	Along a public road and ditch recorded only if over 40 percent woody
Greater than 40 percent woody less than 15 feet high	(<1) 9	(<1) 2	(0) 0	(<1) 3	(0) 0
Greater than 40 percent woody 15 to 30 feet high	(1) 62	(<1) 25	(<1) 3	(<1) 1	(0) 0
Greater than 40 percent woody over 30 feet high	(7) 351	(2) 98	(<1) 3	(<1) 13	(<1) 1
Mainly herbaceous vegetation (less than 10 percent woody)	(<1) 13	(<1) 3	(0) 0	(<1) 2	(0) 0
Ten percent to 40 percent woody (seedling trees, brush and vines with herbaceous growth)	(<1) 7	(<1) 5	(0) 0	(<1) 3	(0) 0

Channel Wildlife Habitat Relations

There are significant trade-off of values associated with the modification of existing natural eco-systems through channel work. Channel construction creates a habitat of open water and herbaceous vegetation. Maintenance programs will control vegetative succession. Construction and succession creates a diversity of vegetative community structures which various species of wildlife utilize. Once muskrat trapping was a element of tidal and freshwater marshes, but today in many areas trapping is often accomplished in habitats developed by ditch systems. Ease of accessibility plays a part, but so does the quality of habitat. Hunters reap the benefits of well-managed ditch systems with increased population of quail and rabbits. Many blinds are established along hedgerows to intercept deer as they use the visual diversion of the hedgerows to conceal their movements.

Natural Channel Alignment and Dimensional Changes

Natural streams (those that do not show signs of channel work) meander displacing and relocating sediments. An investigation of four sites (selected to typify the Peninsula) indicated that movement of the main channels was more rapid and substantial than was earlier assumed. A staff report is available showing cross-section changes from 1975 to 1978. Natural channels are in a continual state of change with little chance that the cross-sectional dimensions remain static; aggradation of sediments is not directly proportional to degradation of sediments within any reach; streams act as sediment transporters; and an extension of surface areas tends to occur with aggradation of sediments.

Channel Biologic Productivity

The productivity of the Peninsula's Type 1 and Type 7 wooded wetland is high and annual leaf fall provides a large source of organic matter directly to the stream especially during flooding. Low slopes induce slow velocities in the Type 1 and Type 7 wooded wetlands.

Constructed streams will receive leaf litter but the quantity is largely reduced due to the clearing and maintenance of various right-of-way widths. A replacement source of organic matter is obtained from upland herbaceous plants and aquatic submerged and emerged vegetation.

Comparisons of Channel Temperature

Temperature comparisons between constructed and non-constructed channels were compiled during an extended hot period in August, 1974. Sixty-five sites were sampled three times each between the hours of 2 p.m. and 3 p.m. to determine possible variables controlling channel water temperature. Variables recorded included wind velocity, turbidity, cloud cover, depth of water, air temperature, oxygen content, tree cover, shrub cover, aquatic cover, and other herbaceous cover. Ryan instrument recording thermographs were placed in sample channels for a period of four days to determine temperature fluctuations. Periodic sampling was continued for one year after the initial investigation in August. The following four types of channels were compared:

1. Pools from vegetative recovered or non-constructed channels with no surface water flow

2. Constructed channel pools with no surface flow

3. Vegetative recovered or non-constructed channels with surface flow

4. Constructed channels with surface flow

Inferences and conclusions drawn from this study include:

1. Heavy woody vegetative cover acts as a stabilizing component on water temperature fluctuations in streams.

2. Construction or the continued maintenance of a drainage system tends to open up the water surface to increased solar radiation entry and increased temperature. The magnitude of temperature change is low enough (for waterways inspected) that the influences on types of aquatic life are thought to be insignificant. Exposure of the water to sunlight increases the growth of algae and aquatic vegetation, thereby increasing the dissolved oxygen content of the water.

3. Turbidity fluctuations are less variable in larger streams. Sandy substrata channels retain less turbidity than areas of clay substrata. Turbidity is not a constant value but is in a continual state of change in most small streams. Turbidity reaches its highest recorded values in periods of flood and drought.

One year old ditch with protective vegetation cover controlling erosion and diversifying habitat.

Sediment Traps

Sediment traps are enlargements of channels which reduce bed load and suspended sediments in a stream. The enlargement reduces the velocity, tractive force, and turbulence to allow more of the smaller sized particles to fall out of suspension. Table III-B presents data on average flow velocities observed in drainage ditches and sediment traps on individual farms and in group projects.

Wildlife Value of Wooded Stream Corridors

Varying land use patterns give variability to the value of woods and wooded stream corridors. The fewer the wooded cover areas the more important each area becomes for most species.

The loss of wooded stream corridors lowers the habitat index value for most species. The highly forested watersheds in the southern part of the Peninsula were not as drastically impacted by the construction of grassed or weedy corridors as were the northern forested areas.

Drainage and Its Effect on Woodland

With the settlement of the Delmarva Peninsula came the impact of man's activities through modification of the hydrologic condition and the resulting effect on existing plant communities. Records on hand constructed channels closely correlate with man's first cultural practices. The flat topography and absence of adequate drainage foster the continual modification and creation of drainageways. Current drainage construction activities differ from the past with the use of modern machinery instead of hand labor. The use of machinery enables construction of larger, deeper, and more extensive systems. In woodland there are presently over 800 miles of constructed channels. The effects of these channels on the associated woodland depends on each individual site. The physical, hydrologic and botanical facts must be determined to predict effects of various types of channel modification on the woodland communities.

Incidental drainage on woodland communities can have several effects. The major effect of drainage is a reduction of floodwater or surface water. When a wooded community is covered with surface water it creates an anaerobic environment surrounding the root system. This anaerobic environment induces a variety of stresses on the plant including water and nutrient uptake, xylem and phloem transport, photosynthesis and transpiration. With drainage the anaerobic environment

Table III-B - Average constructed condition velocities, Delmarva Peninsula.

	Ditch velocities	
	On-farm	Group
Lower Delmarva	1.10 ft./sec.	1.45 ft./sec.
Upper Delmarva	1.80 ft./sec.	2.20 ft./sec.

	Sediment trap velocities	
	On-farm	Group
Lower Delmarva	0.55 ft./sec.	0.73 ft./sec.
Upper Delmarva	0.90 ft./sec.	1.10 ft./sec.

Reduction of velocity from drainage channels into sediment traps is approximately 50 percent.

Sediment traps create fish and wildlife habitat.

Sediment traps collect bedload and reduce suspended matter.

is eliminated but drouth stress can occur on the plants. At times, the individual plant will suffer more from the drouth environment than it would with the anaerobic environment, but at other times the release from water stress will induce greater growth.

Field investigations were made to determine if existing cropland drainage programs were having any impact on the forested areas of the Basins. The three primary elements examined were the effect of drainage on tree growth, reproduction, and access for management and protection. Observations were made on ditches which had been in place from four to thirty years. The trees sampled were all within 100 feet of the channel. Information on depth to water tables was available from existing "well data". All the samples were taken on alluvial soils.

The data gathered showed a very slight overall reduction in growth of the trees which occupied the sites at the time the channels were installed. This was not consistent, however, as some of the trees showed slight increases in growth. Nor did there appear to be any direct correlation between water table depths and the changes in growth rates of the trees sampled. Growth increased the same with shallow water tables as with deeper ones, and just as much slower growth occurred on areas with deeper water tables as with more shallow ones. An analysis of water table levels prior to and after construction of the channels could not be made because the "well data" available was gathered from wells installed after the channels were built. From the position of the sample trees in the stands, it appeared that the trees nearest the cleared rights-of-way were the ones exhibiting increased growth and the ones in the interior of the stands were the ones showing a growth slow down. This could be because of a release from competition of the trees nearest the clearing while those further from the opening had increasing competition with other trees.

Natural reproduction along the edges of the structures, as well as within the forest stands, consisted mainly of those species present in the overstory. Loblolly pine, red maple, sweet gum, and tulip poplar predominated. While these observations appear to be inconclusive as to the impacts of drainage on forest land, it should be noted that these channels were neither designed nor installed to drain forest land. They pass through forest land enroute from the areas of cropland being drained to outlets. While these channels probably hasten the runoff of excess surface water to some degree, they would contribute little to lowering adjacent water tables significantly. This was illustrated to some extent by Ecol Sciences, Inc. (1976) when they made an assessment of economic and environmental effects of completed projects in Worcester and Wicomico Counties, Maryland. They found that ground water levels varied without a distinct pattern throughout the study period. In most cases, the observed ground water levels did not display a statistically significant correlation with rainfall or with water levels in nearby streams. However, ground water levels normally exceeded the water levels in the nearby channels.

Although the average depth to ground water in the PL 83-566 watersheds was greater than that observed in the non PL 83-566 watersheds, the available data are not sufficient to attribute the differences to channel modification. Local variations in soils, topography, and vegetation appear to affect the observed ground water levels. Data from a transect of wells in the Coonfoot Branch Watershed indicated that the PL 83-566 channel influences ground water levels 350 feet from the channel. In this transect, correlations between ground water levels and water levels in the channel decreased with distance from the channel. As mentioned earlier, these observations and assessments were made on stands of trees existing at the time the channels were installed and cover a relatively short period of time. These findings cannot be used to project long-term impacts of drainage on forest land. Succeeding generations of trees could, and in some cases will, exhibit different growth patterns than present stands. Species changes could occur, i.e., bottomland hardwood to pine or upland hardwood types or any combinations of these types. It is also conceivable that in areas where the berm or spoil banks of drainage ditches are placed in such a way that natural drainage is impeded, the type changes could be from pine or upland hardwood to the bottomland or swamp types. The particular varieties of plants in wet areas have adapted themselves physiologically to the existing site conditions and any alteration of these conditions will affect the plants.

One immediate and permanent impact on forest land from the existing channels is the direct loss of forest cover in the channel rights-of-way. While this clearing is a loss of area available for timber production and forest type wildlife habitat, it does have some beneficial effects for wildlife. The additional "edge effect" created and diversity of food plants introduced on and adjacent to the cleared areas is usually beneficial.

No effort was made to correlate growth rates with climatic cycles to see if the changes in growth could be attributed to wet or dry cycles.

As mentioned earlier, the impacts of drainage on forest land being addressed is not designed to implement specific changes in the forest land. It is the impact of agricultural drainage on forest land and this usually means the disposal channels used to transport agricultural drainage "off site". No collection ditches were placed in the forest land to facilitate forest land drainage. Surface water usually does not move freely over the vegetated surfaces or wetlands. Impacts from this incidental drainage are subtle and difficult to identify. This does not minimize the importance of identifying and quantifying impacts, but it does serve to illustrate the difficulties involved in doing so.

A drainage program designed to alter the water tables in wet forested areas would of course have an impact on the existing vegetation and succeeding generations of trees. The effect on existing populations

of plants would, in most cases, be negative. This is illustrated by the changes in species, growth patterns, and access that occur naturally during prolonged periods of drought or excessive rainfall. Water management programs are designed to accomplish or regulate these same effects through artificial means.

Vegetative Conditions After Construction

Natural reproduction along the edges of ditch structures and off into the adjacent woodland was influenced by soil type, hydrologic condition, availability of seed source, and weather conditions following the initial disturbance of sites. The vegetation of the berm varies according to the above, but even more to the type and schedule of maintenance. Some sites display a monotypic vegetative stand of planted species such as fescue or sericea lespedeza while others display a complexity of large seeded annuals including foxtail, ragweed, partridge pea, morning-glory, vetch, and mustard.

Available information for determination of vegetative responses from channel structure design and application of various schedules and management alternatives is not sufficient to make sound decisions in all cases. However, through observation certain generalizations can be made:

1. Woodland swamp communities will change species composition when affected by drainage of surface water. Existing species such as cypress will not be regenerated after removal but will be replaced by species usually associated with dryer habitats such as tulip poplar or sweet gum. Cypress with knees 16 to 26 inches will lose the existing knees and generate new knees to heights just above the saturated soil level of two to three inches. The wooded shrub layer and herbaceous communities usually change with increased stocking density and additional species. At times total successional changes are introduced replacing the original species.

2. After construction, tree colonization on the disturbed berm is usually dominated by sweet gum and maple. These trees normally display a capability of attaining trunk diameter of five to six inches in three years. In ten years, heights of 30 feet are not unusual. Stunting and poor growth occurred on a few sites due to chemical availability, acidity, water availability, or some other growth inhibiting variable.

3. When reversed berms are installed they retain wooded swamp conditions where soil and hydrologic properties are conducive. A reverse berm can also lead to impoundment of water on previously dry sites and cause increased stress, even death, to existing vegetation.

4. One-sided construction in areas without well defined channels often leads to large numbers of wind thrown trees due to instability of shallow roots after being severed. A narrow, 12 foot offside clearing will usually remove these unstable trees. Removal by cutting and leaving the stumps will result in expedient vegetative recovery from sucker growth. This vegetation has attained heights exceeding seven feet during the first growing season.

5. Retention of old oxbows and meanders creates a wetland community which can be managed by water control structures.

6. Environmental or scenic trees left in rights-of-way die when spoil is deposited around roots and trunks. Feasible alternatives to establishing environmental or scenic trees in rights-of-way include natural regeneration, planting, or prevention of spoil deposition around trees.

7. Grazing of ditch banks leads to accelerated erosion, loss of drainage efficiency and increased animal waste problems.

Priority Areas Study

Priority Areas Work Groups developed data for the following categories:

1. Agriculture

2. Urban

3. Forestry

4. Biology/natural areas/fish and wildlife

This data is avilable in computer printout form displaying conflicts between categories and also displaying each separately. The data will be displayed in Appendix D with detailed information on use and application.

CHAPTER IV - FUTURE WITHOUT PLAN CONDITIONS

Introduction

This chapter describes expected future conditions without a comprehensive plan of resource development. These projections are simply estimates of future conditions under carefully defined circumstances. Future without plan conditions assume that there will be no new starts in federal or state assisted projects and no change in federal or state programs which are not already scheduled. These conditions are described in order to assist in identification of future needs, and formulation of alternative plans and comparison of alternatives.

Assumptions

General

Projected conditions are based on long term trends and ignore cyclical fluctuations which characterize the short term paths of our economy. It is assumed that present industries will continue to be a part of Delmarva's economy, that land treatment programs such as soil and water conservation district programs with technical assistance will remain at their present levels, that state and other programs will remain at present levels, and that technology will result in higher per acre yield.

Economic Considerations

Projections of agricultural production at the national level (OBERS Projections) have been made by the U.S. Department of Agriculture. These projections are based on requirements for domestic consumption and estimated exports. When disaggregated to the state and river basin level, they estimate the study area's expected share of a steady flow of products to meet domestic and export demands. Year to year fluctuations in production induced by weather conditions or transitory price differentials are not estimated.

Given the emphasis in the OBERS Series E' Projections on meeting national production goals and the imprecision of disaggregation to the study area level, it was decided that an additional set of projections would be made for production of the major crops in the study area. These projections are based on a consideration of current and projected yields by soil, current and projected land use, the impact of ongoing programs on drainage conditions, and changes in crop rotations induced by changing

drainage conditions. The following are the major assumptions used for this study:

1. Estimated future crop yields are based on the capacity of each soil type to maintain long term productivity under various levels of cultivation intensity.

2. Future location of specific crop acreage will reflect the long term adaptation of cropping systems to local conditions as expressed by cropping patterns in the base year (1974).

3. The production and acreage of minor crops (corn silage, Irish and sweet potatoes, and vegetables for sale) will mirror the expected levels indicated in the OBERS Projections.

4. Cultivation of row crops on land class IVe will decrease by 25 percent by 1990 and by 50 percent in 2000, both projection years. It was assumed that half of the cropland acreage now in class IVe would be converted to hay and pasture use and the other half to forest uses.

5. The failure rate for each crop was assumed to be the same in the future as the average in the base period.

6. Forest land cleared for crop use will be balanced by the reversion of cropland to forest use.

7. Based on an evaluation of potential urban development (residential, commercial, industrial, and auxiliary uses), a substantial acreage of cropland will be taken for urban uses in each projection year.

Within these limiting restrictions, crop production and acreage projections were made by projecting yields and cropping patterns. Detailed input data used in this procedure including soil groupings, current and projected yields, current and projected rotations, and expected drainage conditions by watershed are available upon request.

Social Considerations

The composition of age and sex within the Peninsula population has

important implications for individual resource demands and economic potential. Trends indicate that most young adults will continue to migrate from the farm population into the non-farm sector. This migration will continue to reduce the labor force for existing and potential rural employers and aggravate some existing economic and social conditions.

Environmental Considerations

Future without plan activities will include environmental enhancement practices from ongoing projects such as 208 water quality improvement plans. Programs for wetland preservation, federal cost sharing for water treatment plants, forestry incentive programs, wildlife enhancement programs and others will increase the protection of the environment.

Going Programs

The state agencies' programs should not be affected by the "without development" assumption. The roles of federal agencies will only be altered after about ten years because of projects already approved for operation. Additional assumptions were that there would be no new watershed flood prevention and drainage projects constructed, no group projects installed with federal assistance, and no acceleration of going programs.

Other programs necessary to sustain agricultural production are assumed to continue as part of the future conditions without a plan. Included are the traditional soil and water conservation and erosion control programs of the soil and water conservation districts, with the technical assistance provided by the Soil Conservation Service and U.S. Forest Service. The U.S. Department of Agriculture, colleges, universities, and private enterprise will continue to carry out agricultural research activities.

Programs designed to minimize increases in non-agricultural floodwater damage such as the flood insurance program administered by the U.S. Department of Housing and Urban Development and land use planning by all levels of government are assumed to continue.

Ongoing programs concerned with supply, distribution and quality of water, recreation resources, fish and wildlife, economic and human resources, historical resources, and wetlands will continue at all levels of government and private enterprise.

Authorized watershed projects (PL 83-566) expected to be installed and maintained in Maryland and Delaware are the Upper Nanticoke River,

Marshyhope Creek, Shingle Landing, Dividing Creek, Upper Choptank River, Upper Manokin, and Goldsboro. Four Resource Conservation and Development (RC&D) project measures in the existing RC&D project areas are projected to be installed for the purposes of flood prevention and drainage in Delaware and Virginia.

General Description of Future W/O Plan Conditions

Land Use

The land base for production of agricultural products will diminish over time as more land is converted to highways, homesites, industries, ponds, and other uses. More pressure will be placed on the remaining acres for production. Accordingly, idle land will be brought into production and some forest land will be cleared for crops and pasture, particularly in areas where the timber value offsets clearing costs. Some areas will be planted to trees, and other areas will revert to forest uses. Estimated land use under without plan conditions is shown in Table IV-A. One should note that the modified OBERS Series E' Projections are not OBERS Series E' Projections *per se*, but reflect agricultural land uses implied by the OBERS Series E' Projections of crop acreages in Table IV-B.

The levels of crop production forecast for 1990 and 2000 imply a substantial increase in double cropping as the cropland base decreases due to the conversion of land to urban and forest uses. Some idle crop and pasture land will be brought into production. Idle land was only 5.5 percent of available cropland and pasture in 1974. This probably reflects conditions such as isolation, changes in ownership, death of operator, etc. rather than a lack of economic incentives for production. Consequently, a similar proportion of idle land is expected to remain in future years. While a slight increase in forest land is expected because of the permanent conversion of cropland to forest on steep slopes subject to erosion (particularly in the northern part of the Peninsula), conversion of land to and from forest uses is expected to be essentially equal with no increase or decrease in forest land. Urban land use is expected to increase by 13 percent by 1990 and by an additional 7 percent by 2000 reflecting continuing growth of the population and economy and continued use of local recreation resources by an increasing proportion of the surrounding area's population. No substantial changes are expected in other land uses which are primarily wetlands, beaches, and transitional areas.

Table IV-A - Historical and projected land use, Delmarva Peninsula.

		FWOP[1] study projections		OBERS Series projections	
	1975	1990	2000	1990	2000
	Thousand acres				
Agricultural					
Harvested cropland and pasture	1,531.4	1,585.6	1,546.7	1,481.3	1,759.3
Cropland failure	61.3	63.4	61.9	59.3	70.4
Planted cropland and pasture	1,592.7	1,649.0	1,608.6	1,540.6	1,829.9
Double cropped	162.4	244.4	223.6	136.0	444.9
Cropland and pasture (net)	1,430.3	1,404.6	1,385.0	1,404.6	1,385.0
Idle cropland and pasture	84.5	77.2	74.8	77.2	74.8
Other agricultural use	32.7	32.7	32.7	32.7	32.7
Total agricultural uses	1,547.5	1,514.5	1,492.5	1,514.5	1,492.5
Forest land	1,257.9	1,262.0	1,266.1	1,262.0	1,266.1
Wetlands	370.6	370.6	370.6	370.6	370.6
Urban land	223.4	252.3	270.2	270.2	270.2
All other uses	165.6	165.6	165.6	165.6	165.6
Total land area	3,565.0	3,565.0	3,565.0	3,565.0	3,565.0

1 FWOP - Future without project.

Table IV-B - Production data for major crops, Delmarva Peninsula.

Major crops	1974	FWOP [3] study projections 1990	FWOP [3] study projections 2000	OBERS Series projections 1990	OBERS Series projections 2000
Corn (grain)					
Acres harvested (000)	444.6	545.5	546.2	461.6	641.8
Average yield (bu./acre)	84.2	98.5	108.2	104.3	114.6
Production (000 bu.)	37,435.3	53,738.1	59,116.9	48,155.5	73,548.5
Corn (silage)					
Acres harvested (000)	23.9	28.9	26.3	27.9	25.3
Average yield (tons/acre)	14.1	13.8	14.6	13.8	14.6
Production (000 tons)	337.0	399.0	383.1	384.5	369.2
Soybeans					
Acres harvested (000)	610.8	530.5	523.0	633.7	737.6
Average yield (bu./acre)	24.8	32.4	35.6	30.6	32.8
Production	15,147.8	17,207.9	18,621.3	19,365.5	24,216.9
Small grain [1]					
Acres harvested (000)	201.0	264.3	256.4	185.3	207.1
Average yield (bu./acre)	40.9	43.7	47.7	50.3	59.0
Production (000 bu.)	8,220.9	11,546.1	12,234.7	9,327.6	12,211.4
Irish potatoes					
Acres harvested (000)	28.3	23.8	21.8	23.6	21.6
Average yield (cwt/acre)	154.8	185.3	199.7	185.3	199.7
Production (000 cwt)	4,380.8	4,411.0	4,354.3	4,364.7	4,308.6
Sweet potatoes					
Acres harvested (000)	6.3	10.2	8.7	10.2	88.7
Average yield (bu./acre)	247.4	290.2	318.0	290.2	318.0
Production (000 bu.)	1,558.8	2,960.0	2,766.6	2,960.0	2,766.6

See footnotes at end of table.

Table IV-B - Production data for major crops, Delmarva Peninsula.

Major crops	1974	FWOP [3] study projections 1990	FWOP [3] study projections 2000	OBERS Series Projections 1990	OBERS Series Projections 2000
Vegetables for sale					
Acres harvested (000)	88.1	113.3	100.0	112.2	99.0
Average yield	N.A.	N.A.	N.A.	N.A.	N.A.
Production	N.A.	N.A.	N.A.	N.A.	N.A.
Hay/pasture					
Acres (000)	128.4	69.1	64.3	26.8	18.4
Average yield (tons/acre) [2]	N.A.	2.1	2.3	2.5	2.7
Production (000 tons) [2]	N.A.	144.7	148.2	67.0	49.7
Total acres harvested (000)	1,531.4	1,585.6	1,546.7	1,481.3	1,759.5

1 Wheat, barley, oats and rye.
2 Hay equivalent.
3 FWOP - Future without project.

Source: Census of Agriculture (1974),
OBERS (1990 and 2000)
Delmarva River Basins Study Analysis.

Agricultural Production

As indicated in Table IV-B production of all major crops is expected to increase substantially by 2000. The differences between the study projections of corn for grain, small grains, soybeans, and hay/pasture and the corresponding OBERS Series E' Projections reflect differences in methodology and, to some extent, different assumptions on the availability of cropland in the projection years. Future without plan projections, based on current cropping patterns, indicate a substantially larger acreage of small grains offset by a smaller acreage of soybeans than are indicated by the OBERS Series E' Projections. During the OBERS Series E' base period, however, the rapid introduction of large scale soybean production on the Peninsula implied a much larger future acreage than can reasonably be expected. Similarly, double cropping of soybeans with small grains is a relatively recent phenomenon not fully reflected in the OBERS Series E' Projections. Other differences in the projections reflect different assumptions as to the increase in average yields. Overall, study projections of crop production are greater than the corresponding OBERS Series E' Projection in 1990 and substantially less in 2000. An active program would be required to increase the productivity of the Peninsula's land resources to the increases indicated by the OBERS Series E' Projections in 2000. Such a program may include the promotion of improved technology to increase yields where soil limitations permit, irrigation, drainage, and increased adoption of conservation practices to preserve long term productivity.

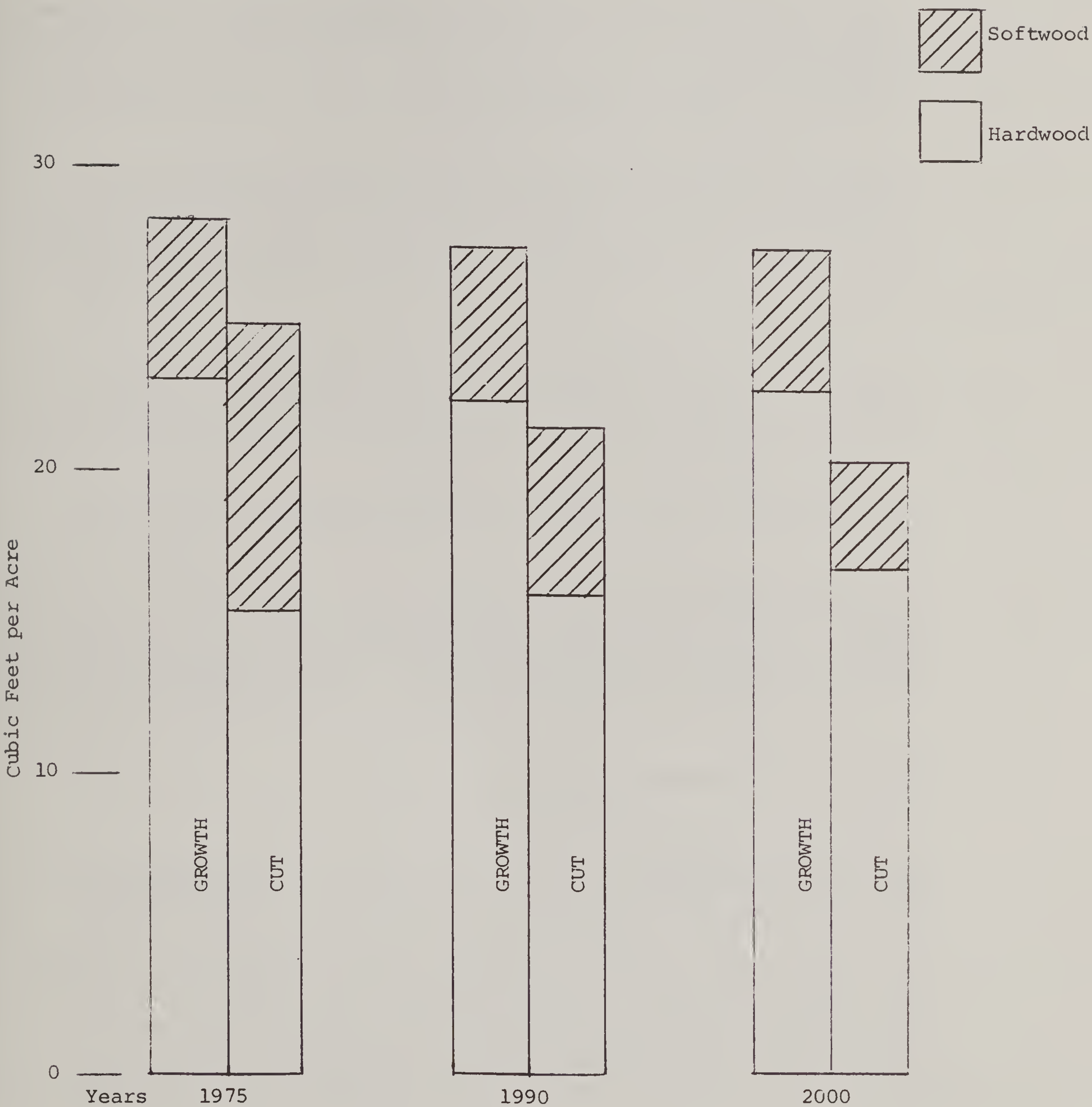
Forestry Production

Annual growth is projected to decrease from 28.10 cubic feet per acre in 1975 to 27.35 cubic feet per acre by 1990 and 27.30 cubic feet per acre by the year 2000 (Figure IV-1).

OBERS Series E' Projections indicate that the basins' forest land should produce a cut of 21.2 cubic feet per acre by 1990 and 30.16 cubic feet per acre by the year 2000 to meet its share of the projected national demand (Figure IV-1).

Under proper management, the commercial forest areas of the Peninsula are capable of growing around 70 cubic feet per acre per year. A study of the projected growth, cut, and OBERS Series E' Projections in Figure IV-1 indicates two things: (1) projected needs will not be met by projected cut after 1986; and, (2) projected needs will not be met by projected growth. It would seem, based on the ability of the forest land to produce an average of 70 cubic feet per acre, that management practices designed to improve stocking and growth, coupled with an increase in cutting, would permit the basins to produce its share of the projected national need. The indicated problem, however, is much greater than this. Figure IV-1 shows the cut and growth broken down by softwood and hardwood. Softwoods (primarily pines) are being cut at a rate

Figure IV-1 - Roundwood cut and growth per acre for future without, Delmarva Peninsula, 1975 and projected 1990 and 2000.



Source: USFS - Timber Resources of Delaware, Maryland and Virginia 1966-1974

much higher than they are being grown and this is projected to continue until 1993 when cut and growth will begin to equal each other. Hardwood growth on the other hand, will continue to exceed cut by a considerable margin.

Net volume of growing stock on the basins' forest land is projected to increase from about 1.8 million cubic feet by 1975 to 3.1 million cubic feet by 1990 and to 4.9 million cubic feet by the year 2000. Net volume of growing stock is defined as the volume, in cubic feet, of live sawtimber and poletimber trees from stump to a minimum four inch top, outside bark, less deduction for rot.

As indicated by Figure IV-1, the majority of this increase in growing stock will be in hardwoods and not softwoods. The more desirable hardwoods (such as red maple, sweet-gum, white oak, and northern red oak) are also being overcut. This means the increase in growing stock volume will be accruing to the less desirable and lower value hardwoods.

The 1971 Soil and Water Conservation Needs Inventories (CNI), updated by past accomplishments to 1975, show the following practices needed on the forest land of the basins: establishment and reinforcement tree planting, 100,100 acres; timber stand improvement, 990,600 acres; and grazing control, 12,000 acres.

The present level of forest management practices with projected accomplishments at this level through 1990 and 2000 are shown in Table IV-C.

It is obvious by comparing the CNI needs figures with those same categories in Table IV-C that these needs will not be met by existing programs at going levels by the year 2000. This same comparison shows also that the greatest discrepancy between needs and accomplishments occurs in the stand improvement category.

Municipal and Industrial Water Use

The Corp of Engineers' comprehensive study, the Chesapeake Bay Future Conditions Report, has projected water use for public water supplies through 2020. The population served and per capita consumption were established for 1970 from data furnished primarily from state department of health records, county water and sewer reports, and other local and regional plans. The bay study area projections did not include New Castle and Kent Counties, Delaware. It is based on water supply systems serving populations greater than 2,500. Water use projections indicate that average municipal and industrial demands will increase from 13.6 million gallons per day (mgd) in 1970 to 17.5 mgd in

Table IV-C - Forest management practices present and projected future with condition, Delmarva Peninsula.

Forest management practices	CNI needs 1975	Average per year	Cumulative totals 1980	Cumulative totals 1990	Cumulative totals 2000
	acres				
Management plans	(1)	8,124	40,620	121,860	203,100
Tree planting					
Open field	(1)	1,724	8,619	25,860	43,100
Reinforcement or conversion	100,100	1,833	9,165	27,500	45,820
Stand improvement	990,600	914	4,573	13,710	22,850
Harvest cuttings	(1)	1,135	5,675	17,040	28,380
Grazing control	12,000	154	771	2,310	3,850
Wildlife habitat management	(1)	84	419	1,260	2,100
Recreation improvement	(1)	11	56	160	280
Urban and environmental forestry	(1)	87	435	1,300	2,180

1 These practices were not identified by Conservation Needs Inventory.

Source: U.S. Forest Service

1990 and 20.2 mgd in 2000. Projections for aggregated water use by small systems show that water use will increase from 6.7 mgd in 1970 to 14.9 mgd in 1990 and 20.0 mgd in 2000. Population increases and increasing industrialization will cause the greater demands for water in the future. [1]

Agricultural Water Use

Rural Domestic Use: The rural domestic water use in the bay study area (excluding New Castle and Kent Counties, Delaware) is expected to increase from 13.9 mgd in 1970 to 24.0 mgd in 1990 and 33.3 mgd in 2000. [2] This represents a substantial demand for water in the rural areas. These demands represent the remainder of the rural population not served by central water supply systems. This rural domestic use is further divided into rural domestic nonfarm components and rural domestic farm use.

Livestock and Poultry: Livestock and poultry water consumption is expected to decrease from 6.4 mgd in 1970 to 4.1 mgd in 1990 and 4.0 mgd in 2000. [3] These projections include New Castle County and Kent County, Delaware. The general decline in water use is primarily because of the decline of dairy operations in Delaware, the decline of dairy operations and beef operations in the Upper Shore of Maryland, the decline in water use by dairy operations, and a decline in broiler operations in the two counties in Virginia.

Irrigation: In the analysis of future irrigation water demands, it is evident that the water use estimated in the Chesapeake Bay Future Conditions Report significantly differs from the historical records presented in the Socio-Economic Base Report, Appendix B.

The divergence between the historical records of irrigation water use and the projected demand is partly due to the method of projecting demand as a function of the crops' net water requirement. Since this is an ideal amount, it may be in excess of the applications currently recorded, which are often determined by each farmer on the basis of experience. The divergence is further compounded by bias in the Census determinations of irrigation water usage. A comparison of data obtained

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1 U.S., Department of the Army, Corps of Engineers, Chesapeake Bay Future Conditions Report, 5:42-46, app. 5.
2 Ibid., attachment 5; F-1.
3 Ibid.

from irrigation water suppliers with that obtained from farmers suggests that: (1) farmers underestimate the amount of water used for irrigation, (2) the suppliers overestimate, or (3) both conditions are true. As stated in the 1969 Census of Agriculture:

> "It was evident, in reviewing the records received from farms in some parts of the country, that some irrigators had no basis for estimating water use in terms of gallons, acre-feet, or depth of application."

Finally, since it has been found relatively easy to correct for errors in responses which overestimate irrigation water by comparing farmers' reports with acceptable maximum application rates, a greater number of underestimation errors in the census data go undetected than overestimation errors. [4]

The combined effect of ideal demand projections and underestimation bias in historical data - plus the fact that projected demands were given for extremely dry years - leads to larger projected increases in irrigation water demands than for any of the other water uses.

On these assumptions, it is projected that irrigation withdrawal demand will increase from 60.6 mgd in 1970 to 324.2 mgd in 1990 and 393.1 mgd in 2000. [5] This means that 19,300 acre-feet was withdrawn for use in 1969. By 1990 an estimated 86,800 acre-feet of water will be needed and 102,600 acre-feet will be needed by the year 2000. [6] These significant increases are due to increased acreages of vegetables, nursery crops and potatoes with projected application of new irrigation systems on three-quarters of the vegetable acreage by 1980 for Delaware (New Castle and Kent Counties included).

The Lower Shore of Maryland will increase its irrigation water demand primarily due to increased application on corn acreage. The Upper Shore on the other hand will decline in crop acreage but increase irrigation application on corn.

There are several major factors which would tend to reduce total agricultural water demand. Such factors are an increase in the rate of irrigation efficiency, the occurrence of more precipitation than projected, and a rapid increase in energy costs. Reduction in demand could also occur.

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4 Ibid., 5:73-74, app. 6.
5 Ibid., attachment 5, F-1
6 Ibid., 5:27, 128, app. 6.

Specific Description of Future Without Plan Condition

To arrive at net component needs that should be considered in each alternative to resolve resource problems, each problem was analyzed individually. These analyses included present magnitudes, future changes, and impacts of ongoing programs on these problems.

Soil Loss

Wind and water are the two major forces which induce soil loss and erosion on the Delmarva Peninsula.

Wind induced erosion can occur on any soils which are exposed. Certain soils are more susceptible to wind erosion due to their cohesion properties, aggregate size, soil moisture holding properties, bulk density, and soil surface condition. There are 303,600 acres of cropland soils which are considered to be greatly susceptible to wind erosion. The greatest potential for wind erosion occurs on 24,200 acres of fall plowed land. An additional 38,800 acres are subjected to wind erosion forces due to partial tillage and loss of 60 percent or more of the residue protection. Residue management for erosion protection occurs on 117,100 acres of wind erodible soils with the remaining 123,500 acres being protected by annual cover crops.

Wind erosion rates average two tons annually on susceptible non-protected soils. Projections indicate that, unless economic conditions change, no appreciable change will occur in the status of wind erodible acres. Economic changes could justify planting greater amounts of small grain or a cost-sharing program could be started with the objective of environmental quality.

Sheet erosion caused by rainfall is severest on cropland and approximately 4,500 acres of surface mined land. Investigation of cropland erosion estimated 1.7 tons per acre per year of soil loss in Franklin Branch Watershed, 1.4 tons/ac/yr in the Upper Choptank Watershed and 1.8 tons/ac/yr in the Marshyhope Watershed. Average computed for these three watersheds weighted by area is 1.7 tons/ac/yr. The 1.7 tons/ac/yr can be used as an indicator for the total Peninsula. Sedimentation surveys of Hearns and Fleetwood Ponds, located in Middle Nanticoke and Upper Nanticoke Watersheds, estimated that approximately 5 percent of the sheet eroded soil reach the channels. This means that .08 tons/ac/yr or 53 tons per square mile reach the channels. Coarse grains with heavy bulk density tend to remain in the drainage ditch or stream systems but about 80 percent of the fine sediments enter downstream watersheds or tidewater.

There are 41,100 cropland acres with soils highly susceptible to water erosion. The erosion of these acres contributes greater than

Sheet and rill erosion are the principal types of erosion on Delmarva.

An estimated 303,593 acres are susceptable to wind erosion in Delmarva.

five tons per acre annually. Sheet, rill, and gully erosion are not confined to these areas, but are more likely to occur if proper management activities are not followed. Present cropping patterns have 2,300 fall tilled acres exposed to the greatest impact of erosion. There are 4,890 acres disked or partially tilled with over 60 percent of the protective residue lost. There are 20,566 acres having residue management for erosion protection and an additional 13,355 acres are protected by cover crops.

Projections indicate that unless economic conditions or environmental controls change there will not be an appreciable change in the treatment of water erodible acres. If soil conservation activities are not continued at the existing pace additional acres will be subjected to greater erosion. If these activities are accelerated, coupled with monetary enhancements to induce conservation, the problem would dissipate. A good erosion control plan would be to encourage landowners to take the 41,100 acres out of conventional tillage and place 16,500 acres into no till operation, 16,500 acres in pastureland, and 8,200 acres into woodland.

Beach and Shoreline Erosion

Natural processes have claimed thousands of acres of land around the bays, ocean and their tributaries on the Delmarva Peninsula. Over the past 100 years approximately 25,000 acres of land has been lost by Maryland into the Chesapeake Bay alone.

Shorelines along the Chesapeake Bay, Delaware Bay, and the Atlantic Ocean are continually plagued with erosion. It is estimated from the 1967 Conservation Needs Inventory that 80 percent of the shoreline is eroding at the rate of one foot or less per year, 9 percent at one to two feet, 5 percent at two to four feet, 6 percent greater than four feet. Research is being accomplished to identify methods for erosion control. Pressure for development of shore areas has resulted in land being cleared and dunes flattened, thus eliminating the shoreline's natural defenses against wave action.

The Corps of Engineers in their Chesapeake Bay Future Conditions Report have identified 149 miles of critical shore erosion on the Delmarva Peninsula. This critical erosion was defined as areas where erosion rates were equal to or greater than 3 feet per year regardless of land use and greater than or equal to 2 feet per year on intensive land use, i.e. residential, commercial, or industrial use.

Work by the Maryland Geological Survey found that erosion rates on selected reaches did not change significantly between 1949 and 1975.

Sheet and rill erosion in upper shore county.

Streambank erosion along the Wicomico River

80 percent of the shoreline is eroding at the rate of one foot or less per year.
9 percent at the rate of one to two feet.
5 percent at two to four feet.
6 percent at a rate greater than four feet.

Based on this the 149 miles of critical erosion is expected to continue at the same rates. An additional 19 miles of critical erosion has the potential to occur with proposed development of intensive land use within the next twenty years.

The U.S. Army Corps of Engineers; the state governments; the U.S. Department of Agriculture, Soil Conservation Service; and National Oceanic and Atmospheric Administration have various programs for assistance regarding shoreline erosion problems both present and future. This study will not make recommendations for solving beach or shore erosion problems.

Critically Eroding Areas

Critically eroding areas consist of eroding road areas, borrow pits, construction sites, channel construction, and gullies. These areas when left bare, temporarily or permanently, are subjected to accelerated wind and water erosion. Approximately 11,800 miles of roads on the Peninsula, either surfaced or nonsurfaced, usually have constantly exposed shoulders. Construction sites and channel construction generally expose soil only temporarily, usually less than a year. In the past, borrow pits have remained bare after excavation but sediment control and surface mining legislation will change this. Gullies are related to steeply sloped and non-vegetated areas. Table IV-D projects changes in critical erosion areas.

Gravel and Sand Operations

Surface mined areas account for 4,500 acres of the Peninsula. In the past most mined areas were not reclaimed and contributed sediment to adjacent streams or acted as self-contained ponds without outflow. Future operations will increase total pit area to 4,970 acres by 2000. Present sediment control and surface mining laws insure reclamation of these additional acres. It is expected that each operation after reclamation will have at least one permanent pond created.

Flood and Excess Water Management

According to the 1967 Conservation Needs Inventory, 532,800 acres are subject to flooding. Flooding of these areas results from out-of-bank flow near the channels and inundation of large areas due to accumulation of surface water. Heavy crop losses from flooding are experienced periodically, sometimes occurring several times during the

Table IV-D - Critically eroding areas, Delmarva Peninsula.

Item	Present	1990	2000
	acres		
Road areas	5,700	5,700	5,700
Gullies	12,880	8,560	4,960
Construction sites	5,600	5,600	5,600
Gravel pits	2,100	2,300	2,400
Channel construction	134	230	245
Total	26,414	22,390	18,905

Source: Delmarva River Basins Staff.

growing season. Road and bridge damages occur at points where they cross the channels. In some areas development has taken place along the drainage ways, and buildings and other permanent structures receive damages from flooding.

Rural communities are also damaged by flooding and inadequate surface water drainage. These damages occur periodically in the form of flooded yards, muddy and impassable driveways and roads, and malfunctioning septic systems. All of these contribute to reduced property values and increased health hazards which make such areas somewhat less than desirable. Future floodwater damages (without plan action) are expected to decrease in some areas only to be offset by increases in other areas due to the increase in the quantity and associated value of agricultural products produced.

Drainage

Inadequate surface and subsurface drainage of agricultural crop and pastureland is a severe problem in the study area due to seasonally high water tables and poor outlet channels. Poor drainage conditions on existing cropland limit management options and prevent farmers from meeting desired planting and harvesting schedules and periodically cause partial to total crop loss, severe weed problems, limited use of cover and green manure crops, and shallow root development.

The combination of floodwater damage and inadequate drainage of agricultural crop and pastureland causes reduced yields, limits crop diversification, increases crop production costs, limits the use and effectiveness of lime and fertilizer, and retards the economic growth of the area.

Present trends indicate that losses on cropland and pastureland will increase as old systems deteriorate. This study estimated that 410,940 acres of cropland needed on-farm drainage in 1977 and only 250,280 acres are expected to be installed by the year 2000 under ongoing programs. Installation of farm drainage systems is frequently hampered by the lack of an outlet. Such outlets usually involve several landowners. Increasing costs of outlets and the failure to organize landowners are two key deterrents in providing adequate drainage outlets.

Nonagricultural Floodwater Damage

At least 47 communities have experienced floodwater damage involving an estimated 170 homes and businesses according to the 1972 North Atlantic Regional Study. There are 48.5 miles of roads and some 398 bridges damaged from flooding. These damages are caused by overbank flow, ponding in low areas, and tidal flooding. Damages to homes

Poor drainage conditions prevent farmers from meeting desired planting and harvesting schedules.

Rural communities are damaged by flooding and inadequate drainage.

Approximately 532,800 acres are subject to flooding.

Average annual damages from flooding are estimated to be $ 3,596,400.

and businesses include floors, furniture, clothing, heating systems, merchandise, and buildings. Lawns, shrubs, and other valuables are lost due to standing water. High water also causes inconvenience such as improper functioning of septic tank drain fields, sewage collection systems, and even daily commuting. Future without plan conditions show average annual damages increasing from $3,596,400 in 1977 to $4,837,824 in 2000.

Forestry Management

The major forestry problem is one of low productivity. This is caused primarily by the lack of stocking of desirable tree species in the forested areas of the Peninsula. While this is not true on every acre, even in fully stocked stands, many of the trees are of either a low quality or undesirable species for the available markets. The Peninsula's 1,257,900 acres of forest land consists of 55,000 acres that are well stocked with desirable trees; 325,100 acres that have fair stocking; and 877,800 acres that are poorly stocked. Over 1,221,600 acres are in private, non-industrial ownership. The net annual growth of desirable species on these acres is approximately half of the potential growth.

In addition to the lack of desirable species, inadequate drainage is an additional problem in some areas. From the standpoint of timber production, many areas are too "wet" to produce marketable products. On the Delmarva Peninsula, this means primarily pines. Many areas are so wet that establishment, growth, and harvest of pines are either prohibited or restricted to the point that it is not possible to reap an economic benefit. This problem is not restricted to pines, however, it is just as difficult in many cases to reestablish stands of desirable hardwoods either through planting efforts or natural regeneration. In Maryland, the acreage in the loblolly-shortleaf pine forest type decreased by 22 percent between the two previous forest surveys (a 15 year period). About one-half of this decrease shifted to the oak-pine type while 38 percent went primarily into the oak-hickory type with minor amounts into other forest types.

In Delaware during the same period of time, the acreage in loblolly-shortleaf pine was reduced by half and now makes up about one-fourth of the commercial forest area. Those areas in the oak-pine type increased by about two and one-half times while the oak-hickory types nearly doubled in area. During this time the oak-gum-red maple type decreased by about 8 percent. However, the total area in forest land remained fairly constant. In Virginia the acreage in loblolly-shortleaf pine declined approximately 10 percent while oak-hickory increased by 60 percent during the years 1966 to 1976. Other problems associated with low productivity are inadequate markets, transporation,

and equipment. Incentives are not available to induce the small forest landowners to invest money and labor in forestry management and wait for long term low returns.

A larger demand for softwood than hardwood in the study area is due primarily to the difference in quality between softwoods and hardwoods and available markets. Wood-using industries provide a steady market for the larger, better quality softwoods, thus resulting in a situation where almost twice as much softwood is being harvested than grown. Adequate markets could provide the emphasis needed to better manage the hardwoods. A partial solution to this problem has been the establishment of "pallet mills" to utilize some of the smaller diameter hardwood sawtimber and pulp sized hardwood trees.

Forest Insects and Diseases

Insects, such as the southern pine beetle, and diseases, such as fomes annosus, have taken their toll of timber in the past. An aerial survey in 1971 indicated that the southern pine beetle had infected more than 5,000 acres of the loblolly-shortleaf pine forests. The entire pine lumbering industry could be threatened if epidemics such as this go unchecked.

This is also of concern to the urban or suburban homeowner. It has been estimated that property with trees has a higher value than similar property without trees. So the loss of trees to insect or disease could mean a monetary loss to homeowners. A 1972 study by the U.S. Forest Service showed that property with trees had a value of from approximately 6 percent to 18 percent more than a treeless property.

Water Shortages

The most recent drought period occurred throughout the 1960's on the Peninsula. Most communities on the Delmarva Peninsula depend on ground water sources for water supplies and are not subjected to curtailed water service. Water shortages do, however, affect community waste treatment facilities, industrial surface water use, and recreation. During these periods a certain flow must be maintained to provide a vehicle to remove outputs from treatment facilities and industries and to maintain desired water quality requirements. Through examination of historic records a proper location and design may be made to minimize water shortage effects. It is expected that ground water use will continue to increase due to its availability and reliability.

Drouth conditions prohibit use of pond as a water supply.

Rural areas require adequate water supply especially in emergencies.

Wildlife Resources

The future status of wildlife habitat will depend on the concern and knowledge of the land managers of today. Wildlife is an important by-product of land management. Consequently, problems relating to wildlife will be the result of past and present land managers ability to plan for the future. The farmers, foresters and other managers can control the quantity of wildlife habitat as well as the quality. Management practices such as ditch bank seeding, field border cutbacks, grassed waterways, sediment traps, cover crops, idle land designation, forest thinning, hedgerows, windbreak establishment, roadside borders, odd area management, reforestation, wet area protection, cover creation, cropland residue management, fertilization, artificial home structures, shoreline buffer strips, exclusion fencing, water control structures, habitat rejuvenation through disturbance, forest release, and food plots can all contribute toward a viable wildlife population structure.

Existing and growing future competition between uses of the land base will necessitate greater precaution to preserve and improve wildlife habitat. Theoretically, each acre can supply habitat for some species of wildlife. Few sites preclude wildlife management possibilities. The growth of urban wildlife management is a direct product of the idea that for each acre there is a preferred wildlife management plan that can be applied.

The Delmarva Survey developed a total wildlife habitat analysis system to estimate present relative index values for various habitat areas. These index values were formulated through the consolidation of numerous variables and their effects on individual wildlife species. The system will allow predicted future conditions for wildlife to be estimated under plan and no plan situations. Appendix C gives a detailed discussion on the use and findings of this system.

Freshwater Fishery Resources

The existing resident fishery associated with the present systems will remain static or deteriorate proportional to the rate of aggradation of sediments under future without plan condition. If the system in question is now in a natural channel, a wooded swamp or wooded type association, little change if any is expected to occur. If the system is now in a more modified state with an open canopy to allow sunlight to penetrate, and maintenance is not provided, the productivity from phytoplankton and rooted aquatics will decline as the canopy closes in and sediments deposit. The habitat will change to support a resident fishery similar to preconstructed conditions. Oxygen availability will

decline and energy dynamics will revert to dependence on leaf litter. However, the extent or degree in which any system changes will depend on its management.

Ponds and Lakes

The projected future quantities of ponds and lakes by 2000 show a continual increase. New construction activities are predicted to create 3,100 ponds one-half acre or less, 2,630 one-half to 3 acres and 430 ponds greater than 3 acres. The total for 2000 will be 6,350 ponds one-half acre or less, 5,380 one-half to 3 acres and 900 ponds greater than 3 acres. The total surface area is predicted to exceed 21,000 acres. The above data is based on a ten year trend of pond application over the Peninsula.

Wetlands

The future condition without project activities and with limited or no maintenance will show increasing acreage of wetlands. The channels which have been constructed or modified by man will continually aggrade, building up sediments derived from upland sources and from organic accumulation. The drainage efficiency will decline relative to the rate of accumulation. If the process is allowed to continue, many of the previously wetland areas will return to conditions similar to preman modification. Many land areas which were considered upland prior to man's modification will be subjected to an increasing higher water table, greater surface coverage, and some will take on wetland characteristics. The degree of upland sites affected will be relative to drainage impedement. In the watersheds investigated some land is predicted to convert into Type 7 wooded swamps, or Type 3 inland shallow fresh marshes. Additional acres will become bogs Type 8, and other acres will become fresh meadows (Type 2) and eventually seasonally flooded wooded basins or flats (Type 1).

Water Quality

Fishable and swimmable water quality standards are generally met throughout the Delmarva study area. Certain areas are closed to shellfish harvesting due mainly to buffer zones around sewage treatment plants and high population areas with failing septic tanks. Industrial pollution generated within the study area is minor but some major effects are usually attributed to areas outside the study area boundary. Delaware Bay suffers from pollution, generated in the upper basins

with Philadelphia, Chester, Camden, and Wilmington being major contributors. Oil spills are becoming more common. The Federal Water Pollution Control Act Amendments of 1972 (PL 92-500) require the elimination of point and nonpoint sources of pollution. Most of the larger urban areas are in the process of making adjustments to meet these requirements. Rural areas are just beginning to make plans for water treatment and will require financial assistance to meet the desired conditions.

Treatment of industrial and municipal sewage discharges will steadily improve under existing plans and corresponding water quality improvement should be achieved. Implementation of the improved practices for agriculture and urban activities should also aid water quality standards. Failing septic disposal systems, especially on poorly drained soils, will continue to be a problem.

Animal waste treatment facilities are being installed at an increasing pace. Hog waste lagoons seem to be the most commonly applied system to date with approximately 26 units installed since 1960. Prior to 1960 no agricultural waste systems were installed. If the present trend continues 469 units will be installed by the year 2000 for dairy, hog, beef or poultry operations. Poultry waste will continue to be incorporated into the soil for cropping benefits.

With application of proper management practices animal waste should not be a future problem. The application of efficient buffer strips, lagoon systems, land incorporation and exclusion fencing are presently the most cost effective tools in reducing animal waste pollution.

Other nonpoint sources of pollution are much more difficult to control and will remain a problem in the future. At present, both state and federal agencies are studying methods to measure and limit this pollution. If there is no further assistance from federal programs, progress in this area will be hampered. The Peninsula streams will continue to receive pollutants carried by runoff from agricultural and urban areas. Section 404, PL 92-500, places limitations on dredge and fill operations in waterways and associated lands. This could result in a significant reduction in sediment and other water pollutants.

Scenic Rivers

There are many waterways on the Peninsula which deserve recognition due to their scenic beauty. Rivers preserved in their natural free-flowing state offer a wide variety of recreational potential. The states of Maryland and Virginia have enacted legislation aimed at the protection of some of the scenic rivers within their state boundaries.

The Pocomoke River is the only river on the Peninsula designated under the Scenic River Act of Maryland. The Pocomoke River's character is dominated by approximately 39 miles of excavated main channel, completed by the Civilian Conservation Corps in 1947, and associated wetlands and wildlife habitat. Care needs to be taken to preserve the vegetative features which lend to its visually recovered pristine condition. This would necessitate prevention of all development that could interrupt the scenic integrity. Recreation developments, clear cutting activities or agricultural clearing which negatively impact scenic appeal could be prevented through tax advantages, easement purchase or development of a complete comprehensive management plan which insures that preferred management will be accomplished.

Recreation

The Chesapeake Bay, Delaware Bay, the Atlantic Ocean, and their coastal areas offer a range of outdoor recreation to the public. However, because of increasing leisure time, shortages of recreation opportunities will continue to occur. The three states that make-up the Delmarva Peninsula list these recreation facilities as having the greatest need:

1. Boating access and slips
2. Beaches for swimming access
3. Picnic tables
4. Hiking and walking trails
5. Hunting areas
6. Camping areas
7. Bicycling paths
8. Horseback riding trails
9. Park and playground development
10. Facilities for outside sporting events

Both the private and public sectors will be expected to provide these recreational opportunities.

The Estuary

Present programs for updating treatment of municipal, industrial and livestock waste seem to be adequate. Future treatment of inadequate individual home septic systems do not appear to satisfactorily improve most problem areas. Treatment of nonpoint pollution problems arising from sedimentation and its attached and associated load of agricultural chemicals will continue to be a problem until proper farm chemical application rates along with buffer strips and sediment traps are employed.

Threatened and Endangered Species

The status of threatened and endangered species will further deteriorate if development of constructive management plans are not completed and implemented. Land use and management decisions, if not properly structured, could result in the degradation or complete loss of habitat for threatened and endangered species. A listing of most habitat sites for rare and endangered animals is already available. A listing of sites where threatened and endangered plant species occur is not available. Protection measures for threatened and endangered plant species are presently almost non-existent.

Archaeological, Historical and Unique Scenic Resources

Historical societies seem very active and the protection of many historical sites seems assured. Some sites are being lost due to conflicts with renovation or additional development; others are deteriorating due to inadequate funding or an unaware, unconcerned local population. The very nature of archaeological sites usually hides identification until their survival is in a state of jeopardy from some sort of construction or land movement activity such as highway or watershed construction. It is the policy of most public financed construction projects to stop work if an archaeological site is discovered until the proper authority can examine it. Private developments have no legal restrictions but mcst will contact the authorities if something unusual is unearthed.

CHAPTER V - PROBLEMS, OPPORTUNITIES, AND OBJECTIVES

General

Chapters II and IV have outlined present conditions and projected future without plan conditions, respectively. It is evident that land use on the Delmarva Peninsula has been primarily agriculture and forest. It is also apparent that a problem of competing land resource uses exists between urban, agricultural, environmental, industrial, and recreational interests. Changing land use without careful planning has degraded the quality of water and related land resources in many areas. This chapter will describe resource development problems based on concerns identified in the Plan of Work and modified as the survey progressed. Quantification of these problems, less the impacts of ongoing programs, can be expressed as needs and referred to as component objectives. Table V-A shows total needs and 2000 needs. They are defined as types, quantity, and quality of desired effects. These component objectives will be directed toward improvement in the quality of life through contributions to the objectives of national economic development (NED) and environmental quality (EQ). Component objectives are the basis for plan formulation and will be used to compare the effectiveness of alternatives.

Needs Related to Economic Development

Economic development needs are identified as those that will increase outputs of goods and services and/or increase economic production efficiency. An increase in per acre yields and more efficient farming practices will be necessary to meet expected future production. Increased and more efficient management practices and additional markets are needed to increase forestry production. Other needs relating to solving problems that hinder economic development are also identified in this chapter.

Increased Agricultural and Forestry Production Efficiency

Expected agricultural production in the future includes increased production from improved technology, bringing idle land and some forest land into production and a substantial increase in double cropping. Other contributing factors will be increased irrigation, improved drainage, increased adoption of conservation practices and more efficient use of herbicides and insecticides. See Tables IV-A and IV-B for a comparison of projected land use and production from OBERS Series E' and those made from this study. Production data for major crops

Table V-A - Summary of needs present and 2000, Delmarva Peninsula.

Component objectives - element	Unit	Amount	
		Present need	2000 need
On-farm systems: Cropland and pastureland	Ac.	410,940	315,860
Improved water supply and distribution systems (greater than 2,500 population):			
Water supply - wells	Mgd.	18.4	0
Expanded distribution system (same)	No.	12	0
Critical erosion damage reduction			
Road areas - treatment	Ac.	5,740	5,740
Gullies - treatment	Ac.	12,880	4,960
Construction sites - treatment	Ac./yr.	5,600	5,600
Borrow pits - treatment	Ac.	2,100	2,400
Channel construction - treatment	Ac./yr.	134	245
Wildlife habitat improvement			
Artificial home structures:			
Wood duck	No.	4,000 [1]	4,000
Fox squirrel	No.	5,200 [1]	2,700
Food plots	No.	2,100 [1]	0
Roadside shrub borders	Mi.	220 [1]	220

Table V-A - Summary of needs present and 2000, Delmarva Peninsula.

Component objectives - element	Unit	Amount: Present need	Amount: 2000 need
Aquatic vegetation establishment with on-farm and group channels	Ac.	5,540 [1]	3,680
Sediment trap fish habitat	Ac.-ft.	2,270 [1]	1,515
Channel (outlet) fish habitat	Ac.-ft.	4,790 [1]	3,540
Fish ponds construction	Ac.	7,654 [1]	0
Herbaceous waterways	Ac.	1,210 [1]	0
Cover crops and crop residue management	Ac.	346,560 [1]	70,800
Forest - wildlife management:			
Thinning	Ac.	24,000 [1]	24,000
Fire	Ac.	48,000 [1]	48,000
Odd area plot management	Ac.	7,700 [1]	7,700
Cropland waterfowl water control structures	No.	1,000 [1]	1,000
Agricultural waste systems			
Install systems	No.	469 [1]	0
Preserve natural beauty			
Scenic rivers	No.	1 [1]	As Designated

Table V-A - Summary of needs present and 2000, Delmarva Peninsula.

Component objectives - element	Unit	Amount: Present need	Amount: 2000 need
Wildlife area improvement			
Hedgerow establishment	Ac. Mi.	18,910 [1] 15,180	12,400 11,050
Hedgerow improvement	Ac. Mi.	3,780 [1] 3,040	2,480 2,210
Ditchbank herbaceous habitat:			
Cropland and pastureland	Ac.	56,050 [1]	37,200
Shrub edge release	Ac.	5,350 [1]	2,930
Fish pond management	Ac.	21,214 [1]	13,560
Exclusion fencing around ponds	Mi.	3 [1]	3
Shoreline buffer strips	Mi.	1,060 [1]	1,060
Preservation of habitat for threatened and endangered species (sites)			
Site identification and selection		Identified on maps 1-17	
Protection of wetlands			
Wetlands		Identified on maps 1-17	

1 Needs are expressed as goals.

with existing programs is found in Table V-B. The basins have potential for more agricultural production than presented in Table V-B if improved drainage, irrigation and cultural management can be provided. An expanding poultry and livestock industry offers a great opportunity for local farmers to intensify production of grain and soybeans to meet area demands.

If forestry production is to increase, past trends in application of forest management practices must be changed. Increased management practices including stand improvement, establishment and reinforcement tree planting, and others must be implemented.

Efficiency of forest operations should be enhanced by the creation of additional markets so that economic utilization of marginal woodland species and woodland residue can occur. Presently, there are a total of 94,600 acres of establishment and reinforcement tree planting, and 987,860 acres of timber stand improvement needed. Another major problem and limiting factor for forest production efficiency is the inability to perform management practices on wet sites.

Drainage and Floodwater Damage Reduction

Drainage and floodwater damage reduction needs are inseparable on most problem areas of the Peninsula. Additional hydrologic studies are necessary to separate these needs and will be accomplished only if detailed planning is requested for any project. There are 4,870 miles of outlet channels needed for cropland and pastureland, that will not be provided by ongoing programs. Ongoing programs will provide 250,280 acres of the total 566,140 acres needing cropland and pastureland drainage by the year 2000. Improved drainage will allow landowners to diversify their cropping operations, effectively use lime, fertilizer, and pesticides, permit timely use of equipment, permit proper and timely cultivation practices and reduce total production costs. Yields are expected to increase on an average of 25 percent or higher for most wet soil associations.

Nonagricultural Floodwater Damage Reduction

Outlet channels designed for on-farm drainage systems have very little effect on reducing nonagricultural floodwater damages unless additional features are added. Outlet channels, can be designed to be very effective in reducing floodwater damages. Nonagricultural floodwater damage has not been evaluated in this study.

A combination of channel construction, zoning, flood proofing, and relocation can be very effective in preventing floodwater damages.

Table V-B - Production data for major crops with existing programs, Delmarva Peninsula.

Crops	1977	1990	2000
Corn (bu.)	47,159,000	53,738,100	59,116,900
Small grain (bu.) [1]	10,653,200	11,546,100	12,234,700
Soybeans (bu.)	14,547,500	17,207,900	18,621,300
Hay/pasture (tons) [2]	165,300	144,700	148,200

1 Wheat, oats, barley, rye.
2 Hay equivalent.

Forty-seven communities on the Peninsula are actively participating in the flood insurance program. [1]

Municipal and Industrial Water Use

The Chesapeake Bay Future Conditions Report [2] projects that there are 12 water service areas on the Peninsula that have public municipal systems (greater than 2,500 population). This number does not include systems in New Castle or Kent County, Delaware. All of the systems use ground water as a water source. Presently all of the systems have sufficient capabilities (pumping capacity) to serve one day maximum water use demands. By 1990, 10 systems will have a source system demand totaling 13.0 million gallons per day. By the year 2000 all 12 systems will have a 18.4 million gallons per day demand. Ongoing programs are expected to satisfy these needs with improved and/or expanded pumping systems.

Irrigation Water Use

In 1990 an estimated 86,800 acre-feet of water will be withdrawn for irrigation and about 102,600 acre-feet will be withdrawn in the year 2000. [3] It is estimated that 59 percent of the present water need is supplied by streams and brackish water. [4] The shift to wells has proven to be a more reliable source of water for irrigation. This shift is expected to supply future needs for irrigation.

There are 306,330 acres conducive to crop irrigation on the Delmarva Peninsula. Ongoing programs are expected to install irrigation systems covering 150,800 acres by the year 2000.

Irrigation application will allow diversity of cropping systems by enabling farmers to plant crops with high cash outlays while eliminating the change for crop failure due to drought. Yields of cash grain crops are expected to increase as much as 100 percent. Germination, growth and yield of double cropping systems becomes less speculative and more prevalent as economic gains become assured.

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1 U.S., Department of Housing and Urban Development, Federal Insurance Administration, INTERA-Fed-HUD Flood Insurance Program Latest List of Areas Eligible for Flood Insurance as of April 30, 1978.
2 U.S., Department of the Army, Corps of Engineers, Chesapeake Bay Future Conditions Report, 5:43, app. 5.
3 Ibid, 5:128, app. 6.
4 Maryland Cooperative Extension Service, The 1977 Maryland Irrigation Survey, by Lewis E. Clark, p. 2.

Other Water Uses

Rural domestic, livestock, and poultry water use account for approximately 34 percent of the agricultural annual needs by the year 2000. The combined consumptive rate of 37.3 million gallons per day is expected to be met by use of existing ground water sources. [5] Ground water sources are available to meet most demands.

Ponds and Lakes

Project activities will stimulate economic growth. Along with economic growth there will be an associated request for more recreation ponds. Total water control in agronomic activities becomes feasible with installed drainage and should stimulate development of ponds for irrigation. NED plan implementation will create approximately 640 surface acres of ponds.

Recreational Opportunities

Needs for increasing recreational opportunities are not quantified in this report. The previous chapter list the facilities that showed the greatest need. Each state's respective recreation department will attempt to incorporate any recreation development that can satisfy these needs when a recommended plan is selected or when proposed project action is requested.

Needs Associated with Environmental Quality

Environmental quality needs are those that conserve, protect or enhance areas of natural beauty, quality of water and land resources, biological resources and selected ecosystems and archaeological and historical resources.

Erosion Damage Reduction

Wind and water erosion on cropland is at times visible, unpleasant, and damaging when it occurs but in most places most of the time it is not visually evident. On the average, erosion is not exceeding the regenerative capacity of the basins' soils. However,

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5 U.S., Department of the Army, Corps of Engineers, Chesapeake Bay Future Conditions Report, 5:90, app. 6.

there are 41,100 acres of cropland on highly erosive soils, 4,500 acres of surface mined land, 149 miles of shoreline, 12,880 acres with gullies, 5,600 acres of construction sites and 11,800 miles of road banks which have been identified as needing protection from erosion.

The ongoing program will treat about 7,920 acres of gullies by the year 2000.

Improved Water Quality

Water quality can be improved by reducing levels of water pollution from agricultural chemicals, nutrients, and sediments carried in runoff water and by controlling runoff from confined livestock operations or urban areas before it reaches streams. In an effort to prevent potential animal waste problems for confined livestock operations and to conserve animal waste as a nutrient resource for crops, many animal waste management systems have been installed on the Peninsula. Soil Conservation Service technicians have assisted in the application of 77 waste management system designs. Most of these systems were either for holding tanks and lagoons for hog operations or holding ponds and lagoons for dairy operations. These units are expected to increase to 287 units in 1990 and 469 units in 2000, thus increasing the application by 270 percent in 1990 and over 500 percent in 2000. The projected needs identified by the 208 Program. Ongoing programs are expected to satisfy all of these needs (see Table V-A).

Wetlands

For wildlife habitat purposes there will be a need to protect and manage all wetlands classified by Circular 39 [6] other than Types 1 and 2.

Fishery Resource

The fishery resource needs to be maintained as a viable functioning element in the ecosystem. To accomplish this habitat factors such as inorganic and organic water quality variables, submerged aquatic vegetation, emergent aquatic vegetation, substrata composition, food availability, and temperature variation must be maintained within acceptable limits. Management plans need to be developed and instituted to assure that habitat quality is retained or enhanced. Elements of

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6 U.S., Department of Interior, Fish and Wildlife Service, Wetlands of the United States, Circular 39, (Washington, D.C.: Government Printing Office, 1970), pp. 18-25.

Shrub swamps provide habitat for diversity of species.

Woodland swamps are highly valuable for nutrient cycling and wildlife habitat.

total habitat management should include: establishment of marsh vegetation communities at the ends and within constructed channels; improvement of sediment trapping ability and stimulation of fish productivity; enactment of effective livestock and other waste treatment programs to insure that fishable and swimmable water quality standards are met; protection of breeding and feeding estuary habitats by control of accelerated erosion; preclusion of dredging performed during reproduction periods, and elimination of domestic and industrial encroachment which can change the physical or biological character of the estuary.

Fishery management input needs to be obtained to increase benefits resulting from channel modification. Management needs to be accomplished on the present and the future lakes and ponds to achieve desired output. Over 21,000 surface acres of ponds and small lakes will need management by 2000.

The benefits that would result from aquaculture have not been achieved due to lack of technology and lack of public awareness. Commercial fish production should be examined in conjunction with various waste treatment facilities, especially in light of research in Israel where hog treatment lagoon systems proved capable of producing 16,000 pounds of fish per acre per year. [7] The fish protein generated by such productivity could easily be incorporated back into hog or chicken feed.

Saltwater aquaculture needs to be examined to determine if technology can be translated into commercial operations to increase production.

Wildlife Resources

The future wildlife resources will be subjected to increased competition from a growing human population and the associated increased demands placed on the natural resource base. Land use changes and different management techniques can inflict a heavy toll on wildlife resources if measures to preserve and enhance wildlife are not implemented. Wildlife habitat improvement is possible on all the present resource base. Formulation of plans to achieve improvement should be stressed.

Hedgerow retention, sediment trap construction, herbaceous establishment, cover crop planting, and other management practices will induce habitat modifications favorable to some species and unfavorable

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7 Dr. Claude E. Boyd, Lecture presented at Auburn University, Warm Water Fisheries Short Course, August 24, 1977.

to others. Total management plans for each watershed need to be developed and implemented to fully realize the future wildlife resource potential. Wildlife needs are expressed as goals in Table V-A. Wildlife and wildlife utilization improve the quality of life for mankind. Any reduction or increase in wildlife or wildlife utilization has a corresponding reduction or increase on quality of life. The USDA should help coordinate activities to set minimum acceptable standards for each specie. Table V-A identifies elements which can be changed to modify the wildlife habitat. Sufficient attention should be given to these elements. Total land use patterns produce significant effects on the wildlife habitat and must be assessed to identify the effects of any management alternative. Achievement of goals will require acceleration of ongoing programs and additional programs of planning and implementation for wildlife. Greater funding and a positive planning approach will be required for future wildlife enhancement.

Hunting Pressure: Hunting pressure is commensurate with wildlife resource availability. If the wildlife resource is managed so that population levels are high and a good relationship between proprietors and the hunting public is maintained, there should be effective resource utilization.

Increased cash flow along with proper management will stimulate resource development. When the hunting public becomes aware of the benefits from on-farm management and the farmer becomes aware of economic benefits derived through sales of hunting privileges for wildlife resources, then a stimulated activity in the management of wildlife should occur.

Preservation of Archaeological and Historical Sites

Archaeological and historical sites are, and will continue to be, preserved by historical societies, government agencies, and the awareness of local citizens. Current statutes appear adequate to safeguard these resources.

Protection and Improvement of Visual Quality

Visual quality is a subject with many different interpretations but one entity is common to all future visual conditions - they are provided for today. Past legislative activities have provided for the protection of wetlands, curtailment of open dumping, beautification of roadways through landscaping activities, and the classification of the Pocomoke River as a scenic river.

Additional acts have been proposed such as the stream corridor approach in Delaware and the open space program in Maryland. Many acts are now in legislative process which can greatly impact the scenic characteristics of the land including the Maryland "State Land Use Act" of 1974 which included a section for the preservation of agricultural land; and additional legislation which mandates the elimination of sales of no-deposit drink cans and bottles. An additional act to secure the natural beauty of waterways by providing scenic easements could be forthcoming.

CHAPTER VI - ALTERNATIVES

This chapter describes the national economic development (NED) alternative and the environmental quality (EQ) alternative developed to meet the objectives outlined in this study. Each alternative specifies component objectives and plan elements that best satisfy its interest. This chapter also describes a suggested alternative with component objectives and plan elements to satisfy the study objectives from the perspective of enhancing the quality of life on the Delmarva Peninsula.

The NED Alternative

The NED objective outlined in the Principles and Standards stresses the role of water resource development in expanding national output of goods and services. Along with the EQ objective, the NED objective is used in the planning process to focus planning efforts on those areas and/or problems where water resource development can make positive contributions to either objective or to both objectives. The NED alternative, however, highlights those activities which contribute to national economic development irrespective of their impact on environmental quality. It thus serves to indicate a single purpose plan of action based primarily on a consideration of economic benefits and costs. To some extent, mitigation of gross environmental impacts is incorporated in the legal design criteria for project activities. The NED alternative is not, therefore, based on the least expensive construction techniques that would be available to a private agency, but include techniques and practices that meet minimum requirements of existing regulations which guide public resource development agencies. No costs which reflect mitigation of environmental impacts specific to the projects evaluated are included except those required as explained above.

In developing the NED alternative, the 109 watersheds on the Peninsula were evaluated to determine the current acreage of cropland on soils with a limitation due to wetness, the linear feet of on-farm ditching in place and projected for installation with ongoing programs, and the miles of outlet improvement needed to provide adequate drainage for existing cropland. Of the 109 watersheds, 15 were excluded from the analysis because of current or recently completed outlet construction. All watersheds are identified in Figure VI-1 (status of Public Law 83-566 watersheds) as the completed and operational projects. Status of other watersheds are also indicated in Figure VI-1. The remaining 94 watersheds were evaluated as 88 possible project areas and benefit-cost analyses were developed for each. Using USDA procedure for economic analysis of resource projects the following assumptions were made:

Watershed Identification

Chesapeake:

8 Chesapeake East
9 Corsica River
10 Wye Mills
13 Lower Chesapeake
14 Upper Manokin
15 Kings Creek
16 Turkey Branch
17 Marumsco
20 Upper Virginia
20-1 Bullbeggar Crk.
20-2 Holdens Creek
20-3 Jacks Creek
20-4 Messongo Creek
20-5 Cattail Creek
20-6 Muddy Creek
20-7 Guilford Creek
20-8 Pungoteague Crk.
29 Lower Virginia

Delaware Bay:

3-1 Smyrna River
3-2 Blackbird Creek
3-3 Appoquinimink R.
3-4 Other Areas
3-5 Cedar Swamp
4 Leipsic
5 Murderkill
6 Mispillion
7 Broadkill

Atlantic:

1 Indian River
2 Bear Hole
7 Lower Virginia
7-1 Tommys Ditch
8 Lower Chincoteague
18 Chincoteague
18-1 Turville
19 Shingle Landing
20 Kitts-Taylorville

Elk:

6-1 Bohemia River
6-2 Sassafras River
6-3 Back Creek
6-4 Crystal Beach

Chester:

1 U.C. (Andover Br.)
2 Chester River
3 U.C. (Unicorn Br.)
4 U.C. (Dudley Br.)
5 Radcliffe River
6 Church Hill Br.
7 Granny Finley Br.

Choptank:

1 Upper Choptank
2 Goldsboro
3 East Goldsboro
4 Forge Branch
5 Garland Lake
6 Ridgely
7 Watts Creek
8 Neck
9 Williston
10 Harmony
11 Long Marsh
12 Germans Branch
13 Jumptown
14 Blackton Branch
15 Norwick Branch
16 Hillsboro
17 Tuckahoe
18 Lower Choptank
19 Bethlehem
20 Preston
21 Cabin Creek
22 Warwick River

Nanticoke:

1 Upper Nanticoke
2 Middle Nanticoke
3 Broad Creek
4 Sharptown
5 Marshyhope
6 Lower Marshyhope
7 Lower Nanticoke
8 Barren Creek
9 Rewastico Creek
10 Quantico Creek
11 Wetipquin Creek

Pocomoke:

1 Upper Pocomoke
2 Green Run Branch
3 Middle Pocomoke
4 Aydelotte
5 Franklin Branch
6 Powellville
7 Timmonstown
8 Ninepin
9 Coonfoot
10 Nassawango
11 Dividing Creek
12 Blackdam
13 Lower Pocomoke
14 Rehobeth Branch

Wicomico:

1 Johnson Lake
2 Beaver Dam
3 Pemberton
4 Tony Tank
5 Siloam
6 Passerdyke Creek
7 Upper Wicomico
8 Lower Wicomico

Transquaking:

1 Upper Chicacomico
2 Chicacomico River
3 Fishing Bay
4 Transquaking River
5 Middletown Branch
6 Little Blackwater
7 Blackwater River

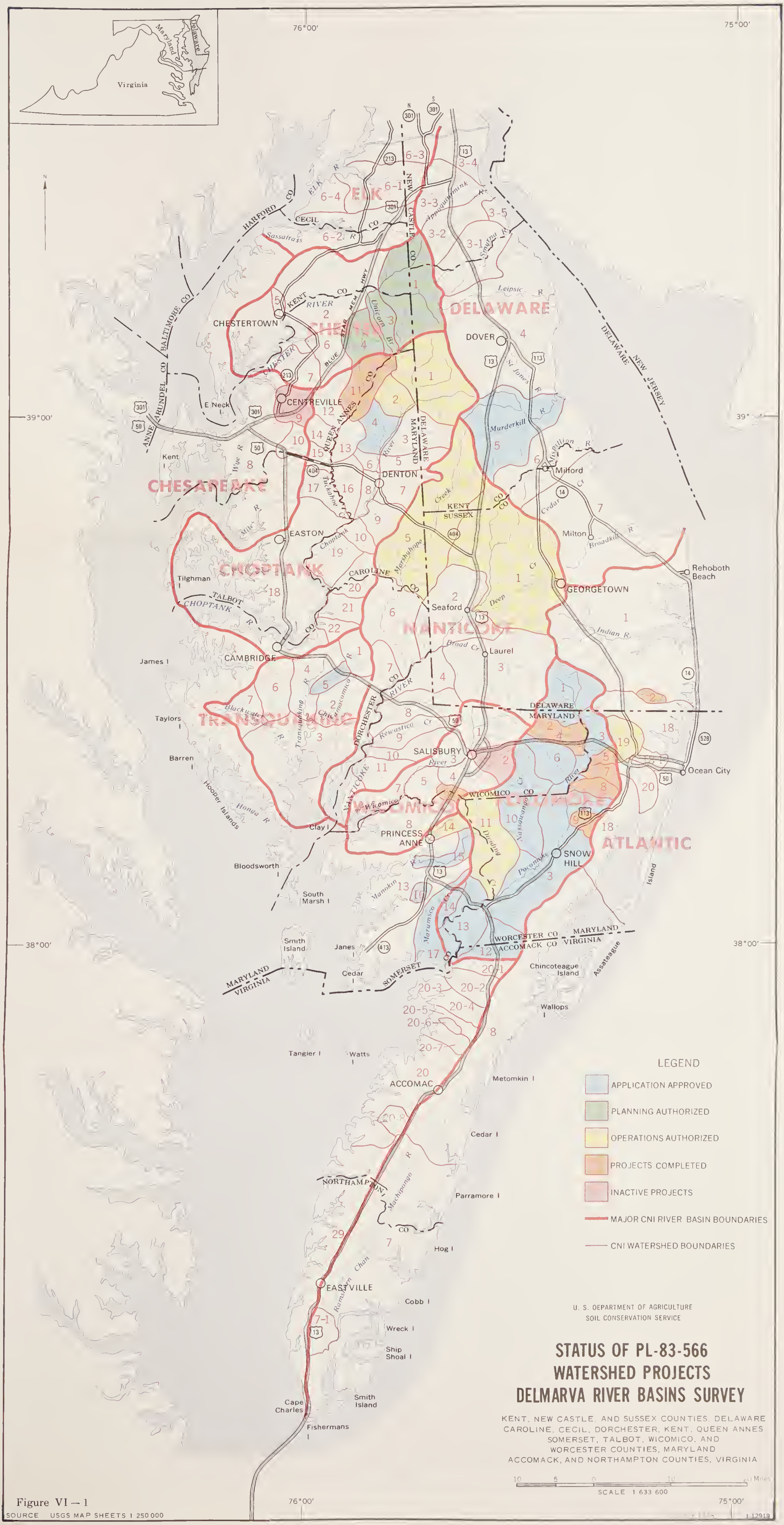

Figure VI — 1

SOURCE USGS MAP SHEETS 1 250 000

1. The discount rate applied to future benefits and costs was 6-5/8 percent.

2. Project life was 50 years and an annual operation and maintenance charge for outlets equal to 3 percent of construction cost was used.

3. Life of on-farm drainage systems was assumed to be 20 years with construction costs amortized at 9 percent.

4. Benefited area in each watershed was assumed to be the total area of IIw-VIIw soils in cropland and pasture uses less the acreage adequately treated in the year of project installation.

5. Benefits shown are exclusively benefits occurring to increased crop yields and changes in crop rotations. No land use change is considered except for conversion of idle cropland to production.

6. Benefits to roads and bridges, residential, and commercial areas, due to reduction of flooding, were not evaluated.

7. Costs shown include costs for outlet construction, operation and maintenance, construction of on-farm drainage systems, and increased variable costs associated with increased crop yields.

8. All benefits and costs were evaluated using current normalized prices and current construction costs.

Using the above assumptions, drainage projects in 51 of the 94 watersheds are justified from an economic standpoint and 11 other watersheds would be justified if non-agricultural benefits and secondary benefits stemming from and induced by the project are included in the benefit-cost analysis. There are 43 watersheds that show a benefit-cost ratio less than 1.00, 32 of which have benefit-cost ratios less than .92 and are probably not justified even with secondary benefits. Table VI-A shows the benefit-cost ratios for the feasible and marginal watersheds. Economically justified nonstructural measures in the project and nonproject areas are also included in this alternative, and are displayed in Table VI-D.

Plan elements for this alternative are displayed with the suggested alternative in Table VI-D. Other pertinent data for these watersheds are also displayed in the suggested alternative section of this chapter, Tables VI-B and VI-C.

Table VI-A - Benefit-cost ratio for CNI watersheds, Delmarva Peninsula.

Watershed name (feasible)	Benefit-cost ratio
Chesapeake East	1.25:1
Corsica River	1.09:1
Wye Mills	1.02:1
Lower Chesapeake	1.17:1
Kings Creek	1.10:1
Turkey Branch	1.07:1
Marumsco	1.05:1
Smyrna River	1.60:1
Blackbird Creek	1.50:1
Appoquinimink River	1.37:1
Back Creek	1.02:1
Cedar Swamp	1.53:1
Leipsic	1.38:1
Murderkill	1.30:1
Mispillion	1.46:1
Broadkill	1.05:1
Chincoteague	1.11:1

Table VI-A - Benefit-cost ratio for CNI watersheds, Delmarva Peninsula.

Watershed name (feasible)	Benefit-cost ratio
Kitts Taylorville	1.50:1
Chester River	1.43:1
East Goldsboro	1.14:1
Forge Branch	1.00:1
Germans Branch	1.10:1
Lower Choptank	1.50:1
Broad Creek	1.28:1
Lower Marshyhope	1.07:1
Lower Nanticoke	1.29:1
Barren Creek	1.40:1
Rewastico Creek	1.16:1
Quantico Creek	1.01:1
Wetipquin Creek	1.10:1
Upper Pocomoke	1.30:1
Green Run Branch	1.17:1
Middle Pocomoke	1.08:1
Powellville	1.04:1
Nassawango	1.09:1
Lower Pocomoke	1.12:1
Johnson Lake	1.15:1
Beaver Dam	1.01:1

Table VI-A - Benefit-cost ratio for CNI watersheds, Delmarva Peninsula.

Watershed name (feasible)	Benefit-cost ratio
Upper Wicomico	1.04:1
Lower Wicomico	1.06:1
Chicacomico River	1.04:1
Little Blackwater	1.28:1
Blackwater River	1.40:1
Holdens Creek	1.16:1
Jacks Creek	1.10:1
Cattail Creek	2.31:1
Muddy Creek	3.08:1
Guilford Creek	1.11:1
Pungoteague Creek	1.28:1
Bullbeggar Creek	1.26:1
Upper Chester (Unicorn, Dudley and Andover)	1.00:1

Watershed name (marginal)	Benefit-cost ratio
Indian River	.96:1
Granny Finley Branch	.96:1
Garland Lake	.98:1
Norwick Branch	.92:1

Table VI-A - Benefit-cost ratio for CNI watersheds, Delmarva Peninsula.

Watershed name (marginal	Benefit-cost ratio
Bethlehem	.92:1
Warwick River	.94:1
Sharptown	.97:1
Blackdam	.96:1
Rehobeth Branch	.97:1
Transquaking River	.93:1
Middletown Branch	.97:1

The EQ Alternative

The environmental quality alternative deals with the total study area including the 62 watershed project areas contained in the NED alternative. The environmental quality alternative is formulated to focus on the more critical needs of the Peninsula. Problems such as sedimentation and erosion are addressed in a manner that attempts reduction of the negative impacts to acceptable limits while not actually attempting elimination of the phenomena. The major elements in the environmental quality alternative are discussed in the following text and most are quantified in Table VI-D of the suggested alternative.

1. Sediment traps should be installed in all water courses that contribute major loading problems. They should be designed using the most up-to-date technology to reduce the sediment transport. Maintenance schedules should be established and periodically inspected to determine changing needs.

2. Cover crop, residue management, minimum and/or no-till farming practices should be expanded to cover cropland soils most susceptible to wind and water induced erosion. Farmers should be urged to reach 100 percent application rates for these practices on erosive hazard soils. Residue management should be defined to specify those practices which will not only limit sediment transport but also provide additional value for wildlife.

3. Open field planting (reforestation) should be accomplished on soils with high erodibility and on soils under conservation measures that do not bring losses within acceptable tolerance limits. [1] High erodibility properties generally include soils with low infiltration capacity coupled with low structural stability on slopes greater than 10 percent.

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1 Soil loss tolerance is the maximum amount of soil loss, in tons per acre per year, that can be tolerated and still achieve the degree of conservation needed for sustained production. The soil loss tolerance values range from one ton per acre to five tons per acre on the Peninsula. (U.S., Department of Agriculture, Soil Conservation Service, Guide for Predicting Rainfall - Erosion Losses, pp. 83-84).

Corn planted in small grain stubble reduces erosion and cuts production costs.

4. Grass waterways, drop structures, impoundments, critical area planting, and other conservation measures should be applied to reduce present erosion rates in areas subjected to gully erosion. Fields should be treated to prevent any gully formations.

5. The inventory and assessment of natural areas on the Peninsula has been accomplished under provisions of Section 305 of the Coastal Zone Management Act of 1972. These areas should be managed so that their physical and biological components are retained in a preferred designated state. Active management plans could be incorporated by state, local and private concerns to retain and enhance these areas. Management plans will incorporate a range of elements from the complete absence of man's interference to the enactment of a rigorous management plan specifying vegetative relations, water level, fire or other control methods. Most natural areas are included in the wildlife priority mapping displays.

6. Woody buffer strips (hedgerows) should be established in all areas that are determined to need that modification of the habitat in order to reach at least the minimum acceptable index level generated through the Delmarva Habitat Analysis System. Woody buffer strips should be managed to retain species diversity and size control by selective cutting. Selective cutting should prevent formation of a monotypic stand of large trees without understory.

7. Landscape planting of various species of trees and shrubs should be accomplished for the specific purposes of noise and pollution abatement, home and industrial energy conservation, and scenic enhancement.

8. Windbreaks should be planted for crop, business, and home protection. Species for windbreaks should be selected to incorporate the multiple objectives of wildlife habitat enhancement, ease of maintenance, longevity, low nutrient and water competition with crops, and scenic appeal.

Grassed waterways control run-off to reduce erosion.

9. Grass buffer strips should be established and maintained on all watercourses not already adequately protected. An average 10 foot buffer strip should be used on farm drainage systems while a specific site investigation usually will be performed on outlets to determine the required width. In many areas existing buffers are inadequate and they should be brought up to an acceptable level. At times woody buffer strips should be supplemented by an additional grass strip. Management of grassed buffer strips should be accomplished to obtain a diverse vegetative community supporting a wide range of wildlife. This can be done by alternating mowing from one side to the other and mowing only as often as is required to manage woody species. Mowing should be done in March to avoid negative environmental impacts.

10. Reverse berms and controlled inlets should be installed on all existing systems where overbank flow erodes the berm due to soil instability. Reverse berms should also be installed through maintenance operations on all wooded sites determined to have been swamps prior to channel work. This will create habitats that are structurally similar to those before channel work.

11. Although protected by law, threatened or endangered species should have action oriented management programs enacted to prevent population decline through habitat protection and enhancement.

    a. The bald eagle management program has as its main goal the stabilization of existing habitat values and should include the enhancement and development of extension habitats. The main outline of the bald eagle program should include retention of woodland and undeveloped shoreline areas, management of nest sites to retain nest trees, removal of those nest trees which have high probability of falling, retention of present policies preventing the widespread application of pesticides such as DDT and its derivatives, development of management plans for each property owner identified in existing or expanded habitat areas, identify management measures that need to be accomplished, protect the water quality to retain an unpolluted food source, and establish hacking stations to introduce captivity-raised eagles in extension habitat areas.

This site is receiving one-sided maintenance while leaving as much vegetation undisturbed as possible to prevent erosion and diversify habitat.

b. The ongoing Delmarva fox squirrel program should be accelerated to meet the objectives of restoring the squirrel throughout its historic range from southern New Jersey and southeastern Pennsylvania down through the Delmarva Peninsula. The program should include trapping and relocation, habitat research, habitat improvement through establishment of nest boxes, and a public education program expressed through the media. The application of the Delmarva wildlife habitat appraisal system should be applied to locate additional areas which would be highly probable for successful reestablishment. The hunting public must be fully informed as to where reestablishment efforts are being attempted. Application of fox squirrel habitat management practices in adjacent areas of establishment should be enacted to extend their range.

c. The Eastern tiger salamander is a species which needs further study to develop a total management program. The present knowledge suggests a limited management program which should protect the sites where they breed. Additional research needs to be accomplished to determine range and habitat requirements. Relocation of egg or larvae stages to some of the over 500 known pothole sites should be considered. Management of this species requires the omission of fish from the breeding hole and protective measures need to be taken to assure that fish are not stocked in these pothole areas. Yearly seine hauls should determine presence or absence of fish before return of the breeding salamanders in early spring and removal should be accomplished if fish are present.

d. The carpenter frog received special attention due to the interest within the states. A carpenter frog was observed at one site during an interagency project to classify wetlands including pothole areas. This siting was noted as a substantial northward extension of the carpenter frog's range in Maryland. Presently it is believed that a

disjunct population of carpenter frogs exist in a number of these pothole wetlands. The management of this species should include retention of all potholes and habitat conditions which are conducive to its survival.

e. The red cockaded woodpecker is thought to exist on the shore and has been reported in Dorchester County. If verification of a population is made then management of this species will necessitate retention of stands of large, old age loblolly pine. These stands should be retained in the immediate vicinity to the nesting colony and in adjacent areas for possible habitat extension. Few of these stands exist.

f. The narrow mouth toad's management should be accomplished where they exist. Borders of swamps and small streams are areas where protective habitat management should occur. No destruction of swamp or small stream habitat should occur where the toads exist.

g. The peregrine falcon's habitat management should have emphasis along the coast and should be the retention of every undeveloped acre. Present activities, including reintroduction through establishment of hacking stations, should be accelerated. Reestablishing a breeding population should include a continuation of the ban on pesticides such as DDT.

h. The ipswich sparrow's habitat management should include the retention of every acre of undeveloped coastal lands. The major problem with this species is the loss of breeding habitat, but the ipswich sparrow's breeding range is outside the Peninsula.

12. The environmental quality alternative includes drainage of selected nonwetland areas with acute needs to eliminate harsh environmental stresses caused by rising water tables and flooding while protecting and enhancing environmental quality.

13. Losses of habitat caused by existing project works of improvement should be mitigated as fully as physically possible and economically feasible by adding measures or features of measures to minimize, restore, replace, or compensate for the loss. The arrangements for installing, operating and maintaining should be explicit. Affirmative action should be taken to assure that all planned mitigation measures are installed and maintained.

14. All wetlands including Types 1 and 2 should be retained. Enhancement of existing wetlands should be accomplished by removal of dumps and other trash accumulation. Various management goals such as waterfowl enhancement necessitate management options on existing wetlands. Mosquito ditching should incorporate environmental values.

15. Critical erosion areas should be treated according to needs:

    a. Borrow pits should be managed to restrict erosion on site and to collect any off-site sediment transport. Methods applied to accomplish this include grading and land shaping followed by revegetation to herbaceous or woody species, construction of the pit to levels forming a permanent pool of water, or spreading top soil and adding nutrients to form viable cropland and other land use possibilities.

    b. Roadways should be managed to restrict their contribution to sediment loading. All roadways should have their shoulders protected from gully formation. Shoulders should be gravelled or grassed to prevent erosion. The present practices of fall or winter shoulder grading should be altered to spring thus allowing time for revegetation. The formation of large acreages of highly erodible exposed material should be prevented. Road drainage outlets should be constructed in a manner to prevent any associated drainage of wetlands. Drainage outlets should incorporate sediment traps and, where practical, should outlet on upland sites.

    c. Construction sites should be managed to limit negative environmental impacts including flooding, erosion and sedimentation. Prior to construction, erosion and sedimentation plans should be required. Many of these plans should retain scheduled erosion

control practices including preconstruction site preparation. Storm water management systems should be developed incorporating sediment traps, on-site storage and drainage system design projecting the effects to the receiving systems.

d. Any construction or major maintenance of ditch systems that occurs should incorporate management and design criteria to limit erosion and sedimentation. Vegetative disturbance should be held to a minimum incorporating one-sided maintenance and limited off-side clearing construction widths of approximately 12 feet. Sediment traps, control inlets, reverse berms, seeding, and other control practices should be applied to limit erosion and sediment transferral. Sediment traps should have scheduled maintenance.

16. Applicable woodland management should incorporate principles where they benefit environmental values. Harvest operations should diversify by incorporating longer rotation, eliminating large clear-cuts, thinning, selective cutting, and species diversification. Drainage and sediment plans should be developed and followed to obtain erosion reduction and retention of drainage systems. In-stream logging operations should be discontinued. Retention of seed trees and/or replanting should be accomplished on all acreage harvested. Woody edge should be retained to form a buffer strip along all perennial streams.

17. Residential and commercial development should be restricted as much as possible but where building occurs it must be on sites with suitable soils. Flood-prone areas should not receive any further development. Development on soils where septic system failure is high should be prevented unless additional adequate waste disposal systems are provided. If building is to occur it should be accomplished in areas that have adequate support facilities including waste treatment, water supply, adequate power and transportation systems.

18. Archaeological and historical sites should continue to be protected.

19. Animal waste management and treatment facilities should eliminate all environmental degradation resulting from domestic animal generated point and nonpoint pollution. Any new farming operations should be required to incorporate adequate treatment facilities before obtaining operation status. As technology in animal waste treatment advances and provides new alternatives it should be applied.

20. Waterfowl use of cropland fields should be enhanced by incorporating design features into old and new ditch systems allowing water level control (temporary flooding) to be accomplished. This should have additional value by providing irrigation, water storage and creating a more efficient sediment trap when flooded. Organic soils will be protected from additional oxidation during flooding periods.

21. A wildlife habitat management system should be implemented using the Delmarva Wildlife Habitat Model to set the lowest acceptable index value for each species. Where management practices, quantity, or interspersion factors are identified by the model as limiting factors provisions should be enacted to correct the inadequacy. If woodland stands large enough to sustain a species are not available then they should be created, etc.

22. Additional clearing of forest land should not be allowed without replacement.

23. Cropland to urban land use changes should be prevented. Certain areas of cropland should be replanted to herbaceous or forest species in order to prevent erosion, act as a buffer for streams, and provide wildlife habitat. Cropland subjected to accelerated erosion should also be treated by conversion to pasture and hay.

24. Retention of natural tree cavities and the creation of artificial home structures should improve the habitat for many species. Planning activties should be applied basin wide to identify areas for selected species that can benefit from artificial home structures. A coordinated effort to distribute these structures plus instructions on where to place them should be available to private individuals or organizations requesting them. Efforts to educate the public on the value of retaining trees with natural cavities and how to create cavities should be accomplished.

25. Wildlife observation sites such as those established for waterfowl should be constructed to establish public awareness for other species; educational programs should be emphasized at the observation sites. Nature trails and other facilities should be constructed on suitable sites where public use seems probable.

26. Ponds should be constructed to develop waterfowl habitat, fish habitat and additional habitats used by numerous species. Each of these ponds should be managed for multiple purposes including fish, waterfowl and scenic. Ponds in pastures should be protected from livestock by exclusion fencing.

27. Shoreline buffer zones should be developed through planting or natural succession. The formation of the buffer strip should vary in width according to site. In highly erodible upland areas with high energy coast lines and sloughing, greater width should be required. In areas with low energy coast lines and slight relief on upland sites the width can be less. A total plan for each landowner should outline a desired buffer zone and give details for their establishment and maintenance.

28. Increased human population places a correspondingly greater demand on natural resources and environmental values. This should be discouraged.

29. Streams should be retained in their present state.

The Suggested Alternative

The suggested alternative for the Delmarva River Basins was selected by the Plan Formulation Committee based on data presented in the NED and EQ alternatives. This alternative combines the most desirable aspects of the NED and EQ alternatives in an effort to meet the present and future needs of the Peninsula through the year 2000. Some values listed under the suggested alternative are lower than those presented in the NED or EQ alternative because the formulation committee identified these values as being realistically obtainable by the year 2000.

The suggested watershed projects included in this alternative were selected from the 62 identified in the NED alternative as justified from a strictly economic perspective. Selection was based on: (1) cost effectiveness, (2) total drainage needs, and (3) approval by the appropriate state soil conservation committee. Of the 28 watersheds selected through these criteria, four were deleted from the suggested alternative.

Middletown Branch and Nassawango Creek were dropped because of known environmental concerns. Turkey Branch and Rehobeth were deleted because of low planning priority. The 24 watersheds in the suggested alternative are as follows:

Basin name	CNI watershed name [1]	Map number
Chesapeake:	Bullbeggar Creek	20-1
	Holdens Creek	20-2
	Jacks Creek	20-3
	Guilford Creek	20-7
	Pungoteague Creek	20-8
Chester:	Chester River	2
	Upper Chester	
	• Andover	1
	• Unicorn	3
	• Dudley	4
Nanticoke:	Broad Creek	3
	Lower Marshyhope	6
	Lower Nanticoke	7
	Barren Creek	8
	Rewastico	9
	Wetipquin	11
Transquaking:	Little Blackwater	6
Delaware Bay:	Murderkill	5
Atlantic:	Kitts-Taylorville	20
Choptank:	East Goldsboro	3
	Forge Branch	4
	Germans Branch	12
	Lower Choptank	18
Pocomoke:	Upper Pocomoke	1
	Green Run Branch	2
	Middle Pocomoke	3
Wicomico:	Johnson Lake	1

1 The locations of these watersheds are shown on the watershed status map (Figure VI-1).

Table VI-B gives physical characteristics of the 24 watersheds and estimated starting time for project implementation. Average annual drainage benefits and costs per benefited acre are shown in Table VI-C.

Watershed projects include structural and nonstructural measures. All of the structural measures for drainage projects in the suggested alternative are in the selected watershed areas. Nonstructural measures in the suggested alternative are described for the entire Peninsula but technical and financial assistance will be accelerated most where watershed projects are approved. Nonstructural and structural measures are further described below:

Nonstructural

Nonstructural measures in the suggested alternative include land treatment measures, land use regulations, and flood proofing that will aid in flood damage reduction.

As indicated in Table VI-D, emphasis will be placed on wildlife habitat protection. Through educational programs and economic incentives landowners will be encouraged to include wildlife management practices. Such practices will include odd area plot management, grass waterways, and preservation of hedgerows.

All known threatened and endangered species and their extended habitats are mapped and should be preserved under this alternative through action oriented management programs.

Type 3 through 19 wetlands and their associated values will be retained or enhanced.

Maryland and Virginia's wild and scenic rivers legislation will be used to preserve some of the streams in their natural state. More detailed identification of some of these streams could possibly result from actions initiated by this project.

Land Treatment of Cropland and Pastureland: Land treatment in the basins will be accelerated to meet erosion and sediment reduction, land resource protection, scenic beauty, wildlife habitat improvement, fish habitat improvement and production efficiency needs. Land treatment under the suggested alternative combines desirable characteristics of both the NED and EQ alternatives. A summary of the land treatment elements assumed for all three alternatives can be compared in Table VI-D.

Table VI-B - Physical characteristics of individual watersheds, Delmarva Peninsula.

Watershed name	Location (county and state)	Major basin	Drainage area (ac.)	Acres benefited[1]	Miles of outlet channels	Feet of on-farm drainage	Estimated project implementation date (starting time)
Upper Chester (Andover, Unicorn & Dudley)	Kent & Queen Annes, Maryland - Kent & New Castle, Delaware	Chester	75,400	14,439	311.6	840,500	1984
Forge Branch	Caroline, Maryland	Choptank	12,400	2,985	47.4	256,300	1981
Bulbeggar Creek	Accomack, Virginia	Chesapeake	7,500	474	8.6	28,100	1979
Jacks Creek	Accomack, Virginia	Chesapeake	2,200	411	2.6	34,400	1979
Middle Pocomoke	Worcester & Wicomico, Maryland	Pocomoke	90,000	10,816	206.3	950,600	1983
Upper Pocomoke	Wicomico & Worcester, Maryland and Sussex, Delaware	Pocomoke	24,600	6,883	45.8	729,200	1985
Lower Nanticoke	Dorcester & Wicomico, Maryland	Nanticoke	30,300	2,872	28.4	215,300	1991 [2]
Broad Creek	Wicomico, Maryland and Sussex, Delaware	Nanticoke	76,600	8,925	81.4	894,800	1991 [2]
Murderkill	Kent, Delaware	Delaware Bay	68,100	6,244	49.2	493,600	1989
Lower Choptank	Talbot and Dorcester, Maryland	Choptank	119,200	24,776	38.1	1,967,700	1988
Guilford Creek	Accomack, Virginia	Chesapeake	5,400	662	4.8	37,400	1981
Pungoteague Creek	Accomack, Virginia	Chesapeake	17,700	874	4.4	65,500	1983

Table VI-B - Physical characteristics of individual watersheds, Delmarva Peninsula.

Watershed name	Location (county and state)	Major basin	Drainage area (ac.)	Acres benefited [1]	Miles of outlet channels	Feet of on-farm drainage	Estimated project implementation date (starting time)
Lower Marshyhope	Dorchester, Maryland	Nanticoke	41,900	5,237	79.5	292,700	1989
Barren Creek	Wicomico, Maryland and Sussex, Delaware	Nanticoke	25,300	3,865	24.6	262,300	1991 [2]
Chester River	Kent, Maryland	Chester	119,200	12,169	82.6	885,800	1991 [2]
East Goldsboro	Caroline, Maryland and Kent, Delaware	Choptank	22,600	4,677	64.4	394,300	1991 [2]
Germans Branch	Queen Annes, Maryland	Choptank	14,800	3,383	54.9	183,100	1991 [2]
Rewastico	Wicomico, Maryland	Nanticoke	17,400	2,773	30.3	218,800	1991 [2]
Johnson Lake	Wicomico, Maryland and Sussex, Delaware	Wicomico	24,100	4,255	52.4	253,200	1991 [2]
Holdens Creek	Accomack, Virginia	Chesapeake	8,000	980	8.1	81,100	1991 [2]
Kitts-Taylorville	Worcester, Maryland	Atlantic	2,600	1,435	7.6	121,600	1991 [2]
Wetipquin	Wicomico, Maryland	Nanticoke	7,500	663	7.5	59,100	1991 [2]
Green Run Branch	Wicomico, Maryland and Sussex, Delaware	Pocomoke	9,000	2,787	30.3	312,300	1991 [2]
Little Blackwater	Dorchester, Maryland	Transquaking	21,100	2,930	20.2	250,700	1989

1 Represents needs remaining after ongoing programs.
2 Expected to be installed between 1991 and the year 2000.

Table VI-C - Average annual drainage benefits and costs per benefited acre, Delmarva Peninsula.

Watershed name	Annual benefit per acre ($)	Annual cost per acre ($)	Benefit/ cost ratio
Upper Chester River	69	69	1.00
Forge Branch	63	63	1.00
Bulbeggar Creek	66	52	1.26
Jacks Creek	23	21	1.10
Middle Pocomoke	14	13	1.08
Upper Pocomoke	61	47	1.30
Lower Nanticoke	71	55	1.29
Broad Creek	63	49	1.28
Murderkill	55	42	1.30
Lower Choptank	51	34	1.50
Guilford Creek	30	27	1.11
Pungoteague Creek	36	28	1.28
Lower Marshyhope	64	60	1.07
Barren Creek	63	45	1.40
Chester River	66	46	1.43
East Goldsboro	66	58	1.14
Germans Branch	73	66	1.10
Rewastico Creek	58	50	1.16
Johnson Lake	62	54	1.15
Holdens Creek	43	37	1.16
Kitts-Taylorville	63	42	1.50
Wetipquin	51	46	1.10
Green Run Branch	62	53	1.17
Little Blackwater	51	40	1.28

Table VI-D - Management alternatives for meeting 2000 needs, Delmarva Peninsula.

Component objectives - element		Unit	Remaining needs	Needs provided by 2000		
				NED	Suggested	EQ
Erosion damage reduction and increased or more efficient production						
Cropland	Diversions, waterways, and contour farming	Ac.	75,950	75,950	60,800	75,950
	Cover crop and crop residue use	Ac.	70,800	70,800	56,600	70,800
	Irrigation	Ac.	155,530	155,530	77,700	0
	Shift from cropland to woodland	Ac.	8,230	0	8,230	8,230
	Shift from cropland to pastureland	Ac.	16,450	0	16,450	16,450
	Drop structures	No.	760	760	760	760
	Land leveling	Ac.	31,380	31,380	31,380	0
Pastureland						
	Improved management	Ac.	72,180	72,180	72,180	72,180
	Ponds	No.	550	150	550	550

Table VI-D - Management alternatives for meeting 2000 needs, Delmarva Peninsula.

Component objectives - element	Unit	Remaining needs	Needs provided by 2000		
			NED	Suggested	EQ
Forest land					
Planting (open field)	Ac.	8,230	8,230	8,230	8,230
Reinforcement or conversion	Ac.	54,280	54,280	16,300	0
Stand improvement	Ac.	967,750	967,750	193,600	0
Floodwater damage reduction and drainage on agricultural and pastureland					
Major outlet channels	Mi.	4,870	4,870	950	0
On-farm systems:					
Cropland and pastureland	Ac.	315,860	315,860	62,290	0
Critical erosion damage reduction					
Road areas - treatment	Ac.	5,740	0	2,900	5,740
Gullies - treatment	Ac.	4,960	0	4,000	4,960
Construction sites - treatment	Ac./yr.	5,600	0	5,600	5,600
Borrow pits - treatment	Ac.	2,400	0	1,900	2,120
Channel construction - treatment	Ac./yr.	245	0	245	245

Table VI-D - Management alternatives for meeting 2000 needs, Delmarva Peninsula.

Component objectives - element	Unit	Remaining needs	Needs provided by 2000		
			NED	Suggested	EQ
Wildlife habitat improvement					
Artificial home structures:					
Wood duck	No.	4,000	0	3,200	4,000
Fox squirrel	No.	2,700	0	2,200	2,700
Roadside shrub borders	Mi.	220	0	180	220
Aquatic vegetation establishment with on-farm and group channels	Ac.	3,680	0	740	740
Sediment trap fish habitat	Ac.-ft.	1,515	0	300	300
Channel (outlet) fish habitat	Ac.-ft.	3,540	0	540	540
Cover crops and crop residue management	Ac.	70,800	70,800	56,600	70,800
Forest - wildlife management:					
Thinning	Ac.	24,000	0	19,200	24,000
Fire	Ac.	48,000	0	38,400	48,000

Table VI-D - Management alternatives for meeting 2000 needs, Delmarva Peninsula.

Component objectives - element	Unit	Remaining needs	Needs provided by 2000		
			NED	Suggested	EQ
Odd area plot management	Ac.	7,700	0	6,200	7,700
Cropland waterfowl water control structures	No.	1,000	0	800	1,000
Preserve natural beauty					
Scenic Rivers	No.	As designated			
Wildlife area improvement					
Hedgerow establishment	Ac. (Mi.)	12,400 (11,050)	0 0	2,320 (1,400)	2,320 (1,400)
Hedgerow improvement	Ac. (Mi.)	2,480 (2,210)	0 0	460 280	460 (280)
Ditchbank herbaceous habitat	Ac.	37,200	0	7,710	7,710
Shrub edge release	Ac.	2,930	0	560	560
Fish pond management	Ac.	13,560	0	13,560	13,560
Exclusion fencing around ponds	Mi.	3	0	3	3
Shoreline buffer strips	Mi.	1,060	0	850	1,060

Table VI-D - Management alternatives for meeting 2000 needs, Delmarva Peninsula.

Component objectives - element	Unit	Remaining needs	Needs provided by 2000		
			NED	Suggested	EQ
Preservation of habitat for threatened and endangered species (sites)					
Site identification and selection				*	*
Protection of wetlands					
Wetlands				*	*

* Identified on maps 1-17, Appendix A.

Land Treatment of Forest Land: The suggested alternative indicates that some needs can be met through an accelerated forest resource development program. Those elements necessary to insure that growth exceeds cut after 1995 include open field planting, stand improvement and reinforcement or conversion.

Accelerating ongoing programs will induce 193,600 acres of stand improvement, 16,300 acres of reinforcement or conversion and 8,230 acres of open field planting by the year 2000. These increases will enable needs to be met by 2000.

Emphasis will also be placed on improved cultural and harvesting methods, and the expansion and/or creation of markets for hardwoods.

Intensive management practices will aid in reducing timber losses from fire, disease, insects and weather. Forest fire prevention, prescribed burning, insect and disease prevention and control, grazing control and harvest cutting are some management practices now being used.

Land Treatment of Critically Eroding Areas: Emphasis will be placed on treating critical areas to improve natural beauty and wildlife habitat, reduce sediment and to protect the soil resource base. Natural vegetation will be utilized as much as practical. Treatment of road areas will include drainage outlets, sloping banks, gravel shoulders and/or vegetation. Construction site treatment includes on-site storage and drainage systems, sediment traps, and vegetation. Treatment of gullies includes waterways, site preparation and vegetation. Channel construction treatment includes establishment of protective vegetation covers, drop structures and reverse berms. Borrow pit treatment includes site preparation and vegetation.

Land Treatment of Other Land Uses: Emphasis will be placed on the development of recreation values and wildlife food and cover in all conservation plans. This will include plantings for wildlife habitat improvement in cropland, forest land and critical areas. Ponds will be constructed to develop waterfowl habitat, fish habitat and additional habitats used by numerous species and provide recreational values and benefits.

Structural

Where nonstructural and land treatment measures cannot satisfy planned needs structural measures will be used. A combination of the three often is effective in solving problems.

Channel Modification: Channels included in the suggested alternative are those most needed to solve agricultural and nonagricultural floodwater and drainage problems. Environmental quality factors such as fish and wildlife values, forest cover, wetlands and archaeological and historical values were considered when selecting the watersheds included in this alternative. This alternative will install 950 miles of outlet channels and 62,290 acres on-farm drainage systems.

Crop Production

The application of drainage and land treatment elements on the 24 watersheds identified in the suggested alternative will increase crop production. The projected increase for crop production resulting from application of the suggested alternative along with future increased yields, continuation of ongoing programs and double cropping is displayed in Table VI-E.

Table VI-E - Production data for major crops, Delmarva Peninsula.

Suggested Alternative	1977	1990	2000
Corn (bushels)	47,159,000	54,816,200	61,882,400
Small grain (bushels) [1]	10,653,200	11,333,000	11,684,000
Soybeans (bushels)	14,547,500	17,272,200	18,755,800
Hay/pasture (tons) [2]	165,300	141,100	139,700

1 Wheat, oats, barley, rye
2 Hay equivalent

CHAPTER VII - OPPORTUNITIES FOR DEVELOPMENT UNDER EXISTING USDA PROGRAMS

Many established USDA programs exist that will provide technical and financial assistance to state and local sponsors and the basins' residents. These programs can assist in the implementation of the suggested alternative for each objective.

Drainage and Floodwater Reduction on Agricultural Land

The Small Watershed Act, Public Law 83-566, can be utilized to install a portion of the suggested alternative. The major use of this authority would be in drainage and floodwater damage reduction.

Since most watershed areas are flat and floodwater retarding structures are not feasible, constructed outlets are the major structural measures that would be installed.

Assistance to Soil and Water Conservation Districts and other qualified sponsors is available for developing group action programs through this law. Applications and project plans must be approved by the state and federal government. The watershed status map (Figure VI-1) shows the watersheds' progress at this time.

As outlined in Chapter V a need exists for additional watershed programs to provide outlets for drainage. The suggested alternative includes 24 watersheds. Before elements can be installed each watershed must be planned according to set guidelines. During <u>detailed planning</u> a local sponsor and public participation are required to develop a comprehensive watershed work plan. This work plan presents the elements that will be installed. Economic, social, and environmental aspects of the alternative plans receive a more detailed analysis than at the <u>broad based planning</u> phase.

In 1962, Congress passed the Food and Agriculture Act (Public Law 87-703) which authorized the organization of resource conservation and development areas. This program authorizes technical, financial, and loan assistance to legal sponsors in approved areas where acceleration of going resource conservation programs will increase economic opportunities for local people. Resource conservation and development areas provide local leadership with the opportunity to coordinate and use local, state, and federal facilities more fully in developing and carrying out a plan of action for the orderly conservation, improvement, development and wise use of natural resources.

Presently two RC&D areas have been approved and authorized for operation. These two area programs are available to provide needed drainage assistance in Virginia and Delaware. A third RC&D area on Maryland's Eastern Shore has submitted an application for program assistance but needs authorization from the Secretary of Agriculture to begin operation.

Some of the proposed and existing RC&D project measures are located outside of the area covered by the suggested alternative and will provide a program to reduce flooding and provide drainage in small communities, towns, and in agricultural areas.

The Farmers Home Administration (FmHA) can make loans to local sponsors to assist in implementing flood prevention projects. Loans are used to finance the local cost-sharing items as required by the individual projects.

Increased Production Efficiency and Erosion Damage Reduction

Land treatment measures on cropland and pastureland or associated treatment measures are necessary to make the project measures effective and protect these measures. USDA programs are available to accomplish this task but local costs are involved.

The regular program of the Soil Conservation Service (Public Law 46) can provide technical assistance through the local Soil Conservation Districts for planning and installing land treatment measures for individuals and groups. An acceleration of this technical assistance is available for watersheds planned under Public Law 83-566 and for areas where project measures are planned in the RC&D project areas.

Programs administered by U.S. Forest Service provide a means to intensify and improve forest management and increase production through tree planting, timber stand improvement and reforestation. In addition these programs provide incentives and training for individuals to increase utilization of roundwood.

The U.S. Forest Service programs that provide assistance are Cooperative Forest Management (CFM), Tree Seeding Production (CM-4), Forest Products Utilization (FPU), General Forestry Assistance (GFA), and Title IV of the Rural Development Act of 1972. The Forest Incentives Program (FIP) is administrated by ASCS in cooperation with the U.S. Forest Service and state foresters.

Critical Erosion Damage Reduction

The USDA programs for the treatment of critical areas include providing technical assistance for all items and cost-sharing on other items. As for most of the other elements, an acceleration of services occurs when a watershed is planned under PL 83-566 or a project measure is planned in the RC&D areas. The Soil Conservation Service and U.S. Forest Service have the major responsibilities for planning and installing these projects. Local landowners or sponsors are responsible for operating and maintaining the installed measures.

Many of these needed elements are not located in the area covered by the suggested 24 watersheds, or in RC&D project areas. Treatment of these critical areas is limited to the technical assistance provided by the local Soil Conservation Districts (Public Law 46). Where the ASCS has county programs that cover these treatment measures, financial assistance is available.

Additional authorization to allow acceleration of technical assistance and cost-sharing for installation is recommended. One method would be to give the Maryland RC&D program operation authority. Another method would be the formation of a legally organized local sponsor for a watershed, several counties, or one county and prepare a land treatment plan for the area.

Animal Waste Treatment

The USDA programs provide technical assistance to operators and landowners that confine animals in such a manner that waste must be controlled. Generally, the assistance is aimed at the small operator or landowner through Public Law 46. Cost-sharing may be provided by the ASCS where the county committee includes such a practice.

Preserve Natural Beauty

At present, there is only one program in the U.S. Department of Agriculture that would administer the plan element of Wild and Scenic Rivers. In the Wild and Scenic Rivers Act, PL 90-542, Congress states that: ".... certain selected rivers of the Nation which, with their immediate environments, possess outstanding remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural or similar values, shall be preserved in free-flowing condition, and that they and their immediate environments shall be protected for the benefit and enjoyment of present and future generations."

The Wild and Scenic Rivers System is administered by the Forest Service, USDA, and Heritage Conservation and Recreation Service, USDI. The Pocomoke River has been identified by the State of Maryland as a Scenic River. There are two methods for adding river areas to the national system: (a) federal legislation, or, (b) state legislation and approval by the Secretary of the Interior. For more detailed information on river classification see "Guidelines for Evaluating Wild, Scenic, and Recreational River Area..." adopted by the Department of Agriculture and the Department of the interior, February, 1970.

Wildlife Area and Habitat Improvement

Section 208 of the Federal Water Pollution Control Act Amendments of 1972 directs the need for river basin and nonpoint source pollution control planning. SCS needs to continue and accelerate assistance to Soil Conservation Districts in pollution control. While controlling nonpoint source pollution with conservation practices, the practices can act as plan elements that provide wildlife area and habitat improvement and recreational values.

Resource Conservation and Development projects can incorporate plan elements, such as roadside shrub borders and shoreline buffers, to address wildlife habitat improvement.

CHAPTER VIII - CONCLUSIONS AND RECOMMENDATIONS

The special studies conducted as part of the survey addressed the need for additional information on previously identified issues. These studies, however, also identified the need for additional research on the complex physical relationships between resource development and its environmental setting. Moreover, changes in existing institutional arrangements were suggested by the results of these studies. A discussion of these suggested changes and needs for additional research is included as part of the study recommendations, although it is recognized that cooperating agencies may not be able to address them explicitly. The following narrative discusses each issue briefly:

1. With increased planning and incorporation of wildlife and environmental options, watershed project implementation should develop into a management tool to provide enhancement measures for both economic and environmental goals. This requires:

    a. Additional planning effort and cooperation between all interests.

    b. Additional legislation that broadens PL 83-566 financial assistance for environmental measures.

    c. Monetary expenditures from other cooperating agencies to achieve their established goals.

2. Research efforts should be initiated to develop the models and data needed to predict impacts from various management and land use changes. This requires the following, with adequate funding of each:

    a. Research on buffer strips and their associated abilities to protect and enhance environmental values. Emphasis should be placed on effective size and vegetative types.

    b. Research on sediment traps and their ability to prolong the life of drainage systems, stop sediment transport, provide habitat for wildlife, and provide fish habitat.

c. Research on ditch maintenance by types and application as it affects wildlife, environmental and economic variables.

d. Research on vegetative types and their establishment along ditches as needed. Knowledge is needed on the rate of recovery and relationships of planted species and natural species.

e. Research the effects on cropland productivity induced by the temporarily flooding of soils for waterfowl management.

f. Research on multiple cropping systems and no-till farm techniques and their values.

g. Identification of possible by-products of animal waste treatment systems which could be developed and used effectively.

h. Research on methodologies to predict impacts of the various activities of man on wildlife habitats. This should include extension of work on the Delmarva Wildlife Work Group's Habitat Analysis System.

i. Research and installation of innovative subsurface drainage systems in slowly permeable soils that normally receive surface drainage treatment.

3. A relationship exists between the level of economic affluence and the ability and desire to manage for wildlife and the environment. To avoid declining public concern for environmental management and drainage system maintenance the following are needed:

   a. Continual maintenance and application of existing and innovative technology to retain adequate drainage efficiency.

   b. The implementation of new drainage systems to replace deteriorated systems.

Well managed channel system benefits man and nature.

Absence of maintenance leads to woodland encroachment.

4. A need exists to educate the public of the possibilities for wildlife management and associated recreational benefits and returns both on the farm and in other areas. This requires:

    a. A pictorial publication to show the management of hedgerows, odd areas, homesteads, woodlots, cropland residues, artificial homes, ditch berms and others for optimal wildlife habitat.

    b. Demonstration farms to display an assortment of conservation and wildlife practices. Tours and wildlife field days should be held.

    c. Mass media field days to demonstrate problems, needs, and solutions of wildlife management.

5. Rare and endangered species of animals and plants and their habitats are inadequately protected if management plans are not developed coherently and adequately implemented.

    a. The existing committees and programs for protection of rare and endangered species must be extended to incorporate habitat extension and enhancement principles in even greater detail than the present activities on the Delmarva fox squirrel.

    b. The habitat requirements of each rare and endangered specie must be defined in order to adequately monitor and manage the habitat.

6. If the needed forest resource goals are to be accomplished, increased management activities must be implemented.

7. Forest management problems with undesirable hardwoods and logging waste could be limited by the development of other markets.

8. Presently, wildlife and environmental management policies are applied to isolated problems, such as construction projects located near wetlands, rather than a comprehensive effort to manage effectively for the enhancement of valuable

wildlife and environmental resources. The development and implementation of total management programs will be an effective approach to this problem.

9. Land treatment measures need to be accelerated and this can best be achieved through economic incentives, education, or legal pressures.

10. Housing and industrial development should be centered around the present facilities including water distribution systems, waste disposal, and transportation. Indiscriminate building should be discouraged in areas where agriculture or forestry land use is highly concentrated.

11. A land use policy needs to be developed for Delmarva which recognizes the desired balance between cropland and forest land management to achieve economic goals in harmony with environmental value.

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WILDLIFE DISPLAY MAPS

APPENDIX A


LEGEND
PERENNIAL STREAM
NON-PERENNIAL STREAM
WOODED PERENNIAL WATER CORRIDORS
TIDAL WETLANDS
SOIL WETLAND ASSOCIATIONS
SUB-BASIN BOUNDARY
WATERSHED BOUNDARY
EAGLE NEST SIGHTINGS
EXTENSION HABITAT OF EAGLE
FOX SQUIRREL SIGHTINGS
TIGER SALAMANDER PONDS
CARPENTER FROG PONDS
MURDERKILL
MISPILLION
BROADKILL
MILFORD NECK
PRIME HOOK NATIONAL WILDLIFE REFUGE
Big Stone Beach
Mispillion River Light
Fort Saulsbury
Slaughter Beach
Shorts Beach
Waterloo
Lewes
Nassau
Mispillion River
Cedar Creek
Milton
Red Mill Pond
Frederica
Lynch Hts
Milford
Lincoln
Ellendale
Harbeson
Houston
Harrington
Felton
Viola
Plymouth
Staytonville
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SUSSEX CO
PENN CENTRAL
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U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
WILDLIFE BIOLOGIC PRIORITY AREAS
DELAWARE SUB-BASIN
MURDERKILL, MISPILLION AND BROADKILL WATERSHEDS
APPENDIX — A
USDA SCS HYATTSVILLE MD 1978

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WILDLIFE BIOLOGIC PRIORITY AREAS
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APPENDIX — A

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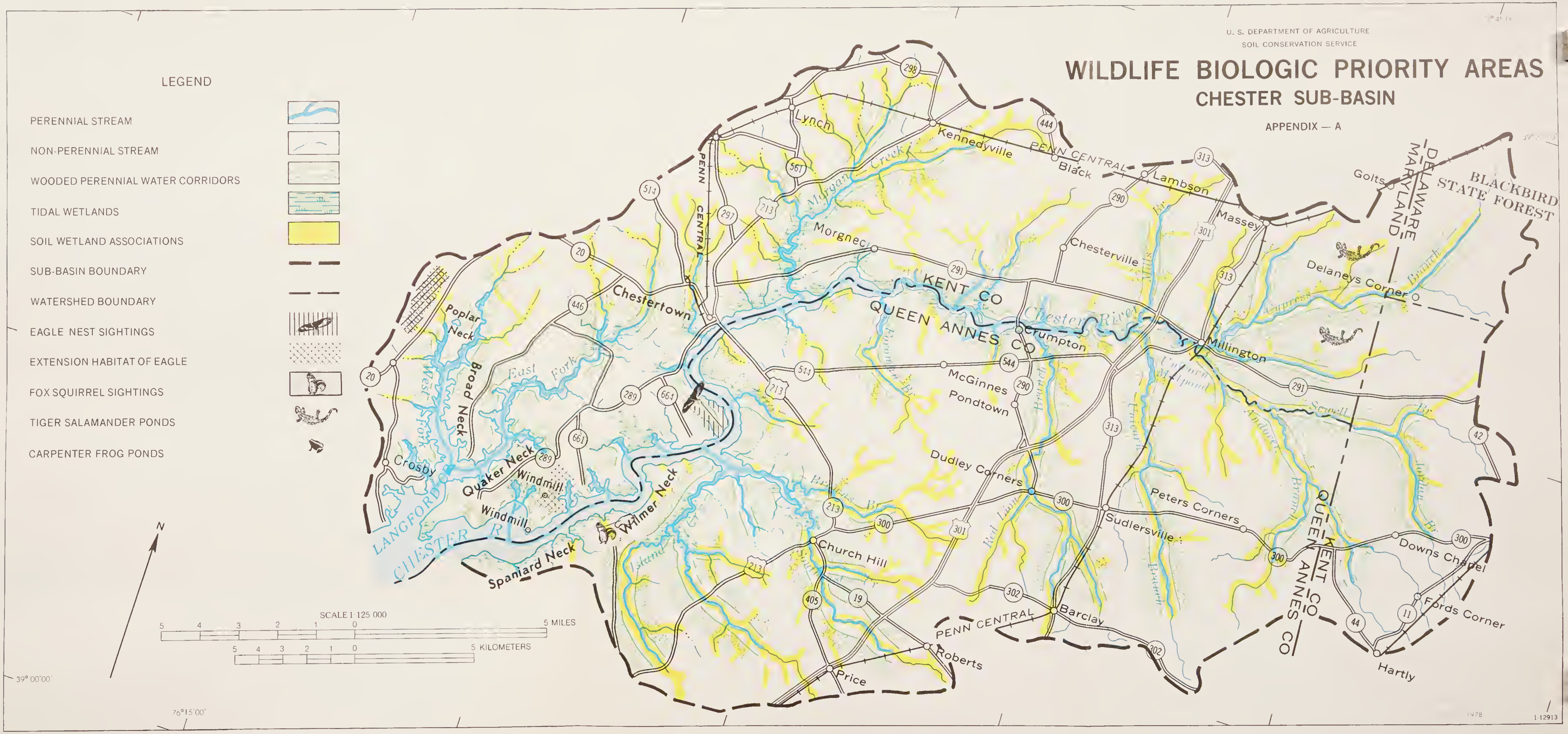

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CARPENTER FROG PONDS
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Black
PENN CENTRAL
Lambson
Golts
DELAWARE
MARYLAND
BLACKBIRD STATE FOREST
Massey
Chesterville
Morgnec
Morgan Creek
Chestertown
KENT CO
QUEEN ANNES CO
Chester River
Crumpton
Millington
Delaneys Corner
Cypress
Poplar Neck
Broad Neck
West Fork
East Fork
McGinnes
Pondtown
Unicorn Millpond
Andover
Sewell
Dudley Corners
Peters Corners
Sudlersville
Crosby
Quaker Neck
Windmill
Wilmer Neck
Spaniard Neck
LANGFORD
CHESTER R
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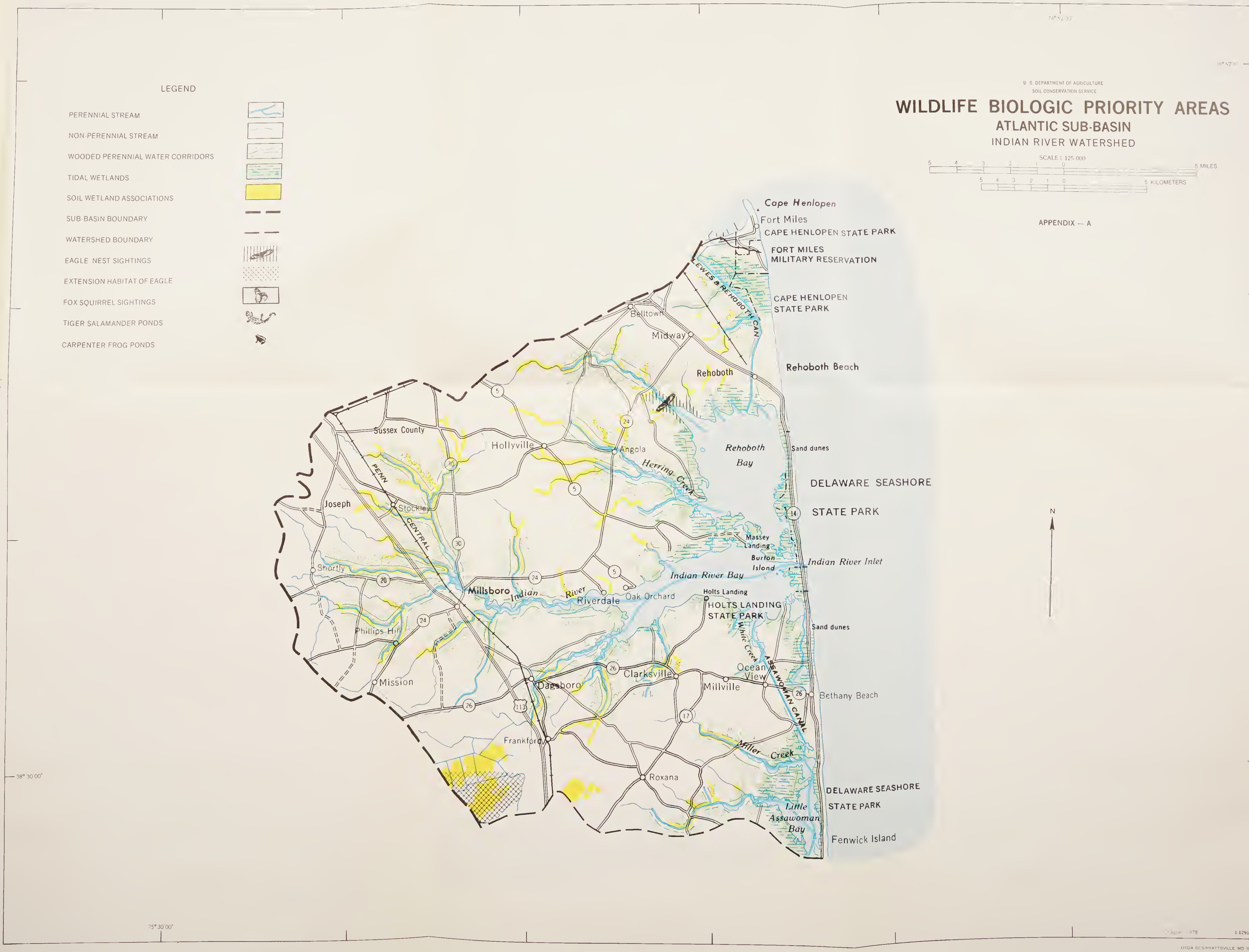

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TIDAL WETLANDS
SOIL WETLAND ASSOCIATIONS
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WATERSHED BOUNDARY
EAGLE NEST SIGHTINGS
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FOX SQUIRREL SIGHTINGS
TIGER SALAMANDER PONDS
CARPENTER FROG PONDS
Cape Henlopen
Fort Miles
CAPE HENLOPEN STATE PARK
FORT MILES
MILITARY RESERVATION
CAPE HENLOPEN
STATE PARK
LEWES & REHOBOTH CAN
Belltown
Midway
Rehoboth
Rehoboth Beach
Sussex County
Hollyville
Angola
Herring Creek
Rehoboth
Bay
Sand dunes
DELAWARE SEASHORE
STATE PARK
PENN CENTRAL
Joseph
Stockley
Massey
Landing
Burton
Island
Indian River Inlet
Indian River Bay
Shortly
Millsboro
Indian
River
Riverdale
Oak Orchard
Holts Landing
HOLTS LANDING
STATE PARK
Sand dunes
White Creek
Phillips Hill
Mission
Dagsboro
Clarksville
Ocean
View
Millville
ASSAWOMAN CANAL
Bethany Beach
Frankford
Miller Creek
Roxana
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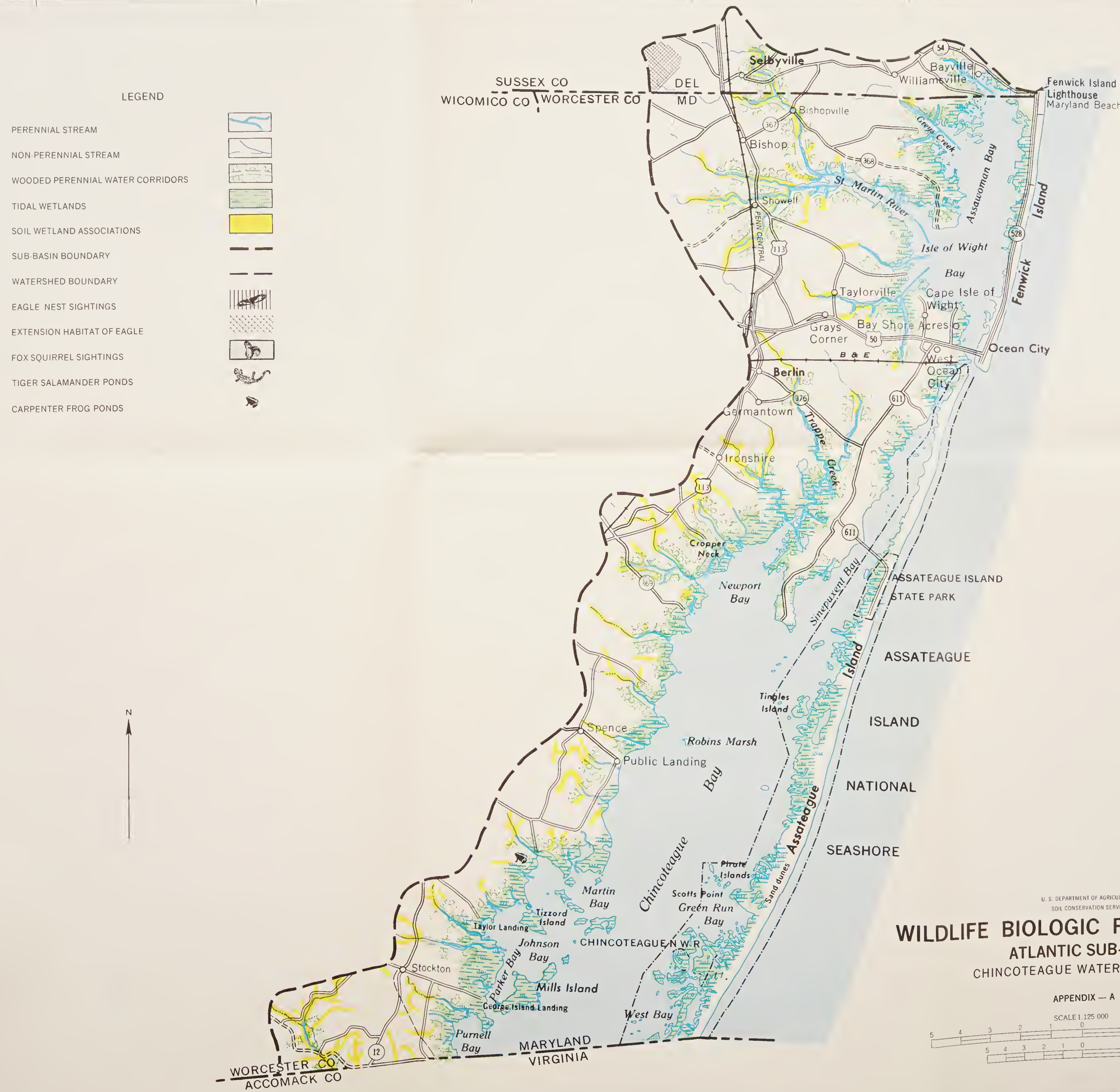

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WILDLIFE BIOLOGIC PRIORITY AREAS
ATLANTIC SUB-BASIN
CHINCOTEAGUE WATERSHED NORTH

APPENDIX — A

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October 1978

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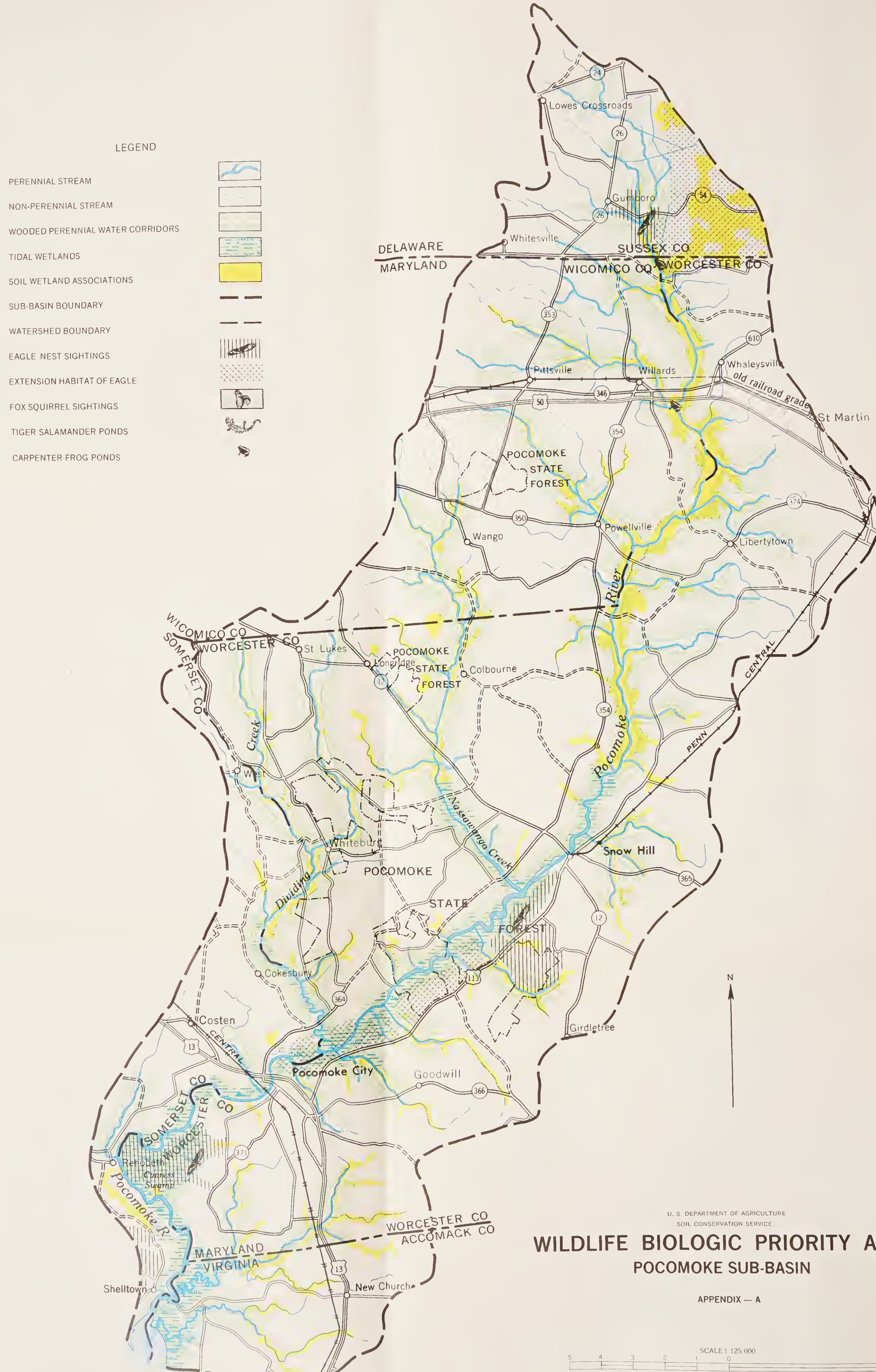

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WILDLIFE BIOLOGIC PRIORITY AREAS
POCOMOKE SUB-BASIN

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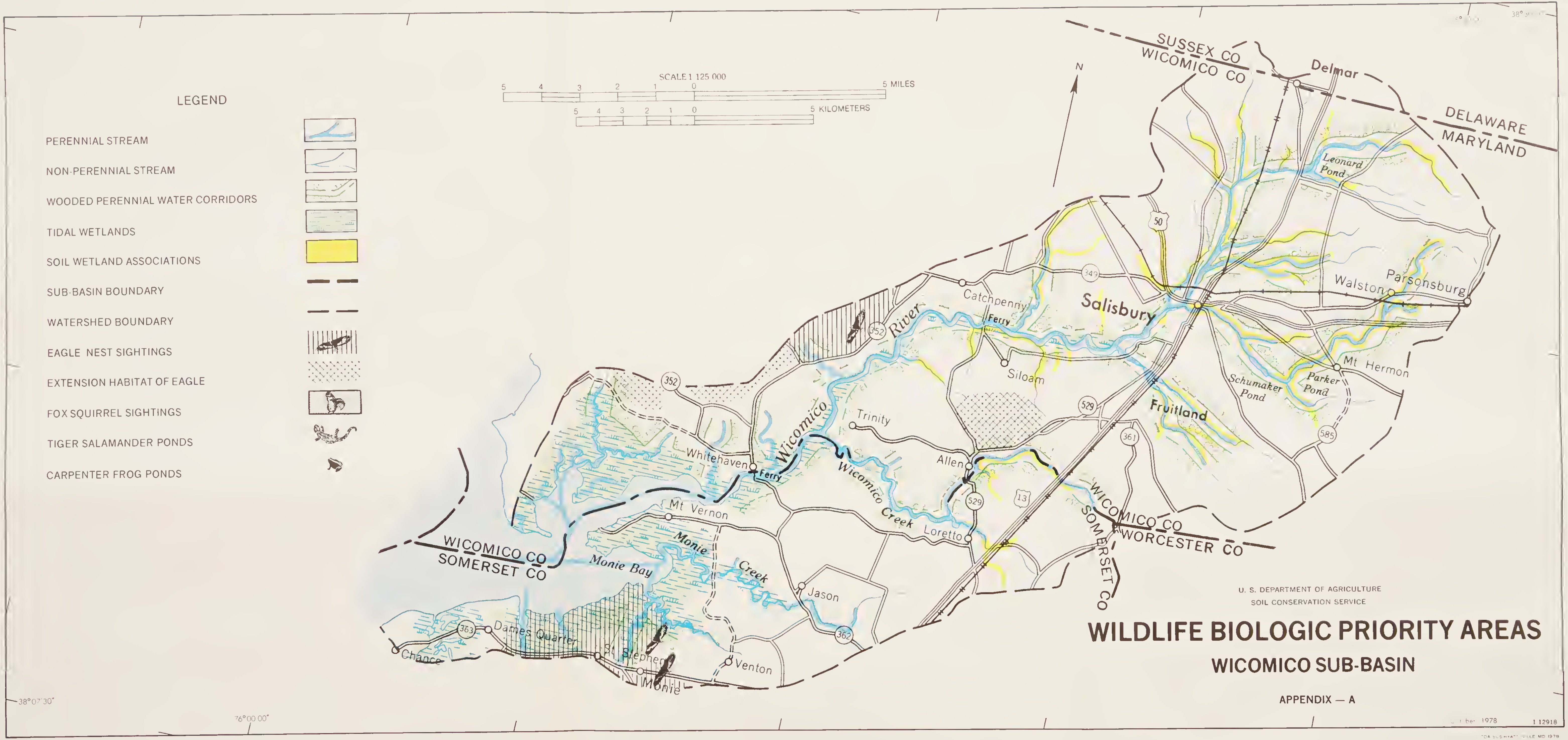

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WATERSHED BOUNDARY
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WICOMICO CO
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DELAWARE
MARYLAND
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349
Catchpenny
Ferry
Salisbury
Walston
Parsonsburg
352
River
Siloam
Mt Hermon
Schumaker Pond
Parker Pond
Fruitland
529
361
585
Trinity
Wicomico
Whitehaven
Ferry
Allen
Wicomico
Creek
529
13
Mt Vernon
Loretto
WICOMICO CO
WORCESTER CO
SOMERSET CO
Monie
Creek
Monie Bay
WICOMICO CO
SOMERSET CO
Jason
362
363
Dames Quarter
Chance
St Stephen
Monie
Venton
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
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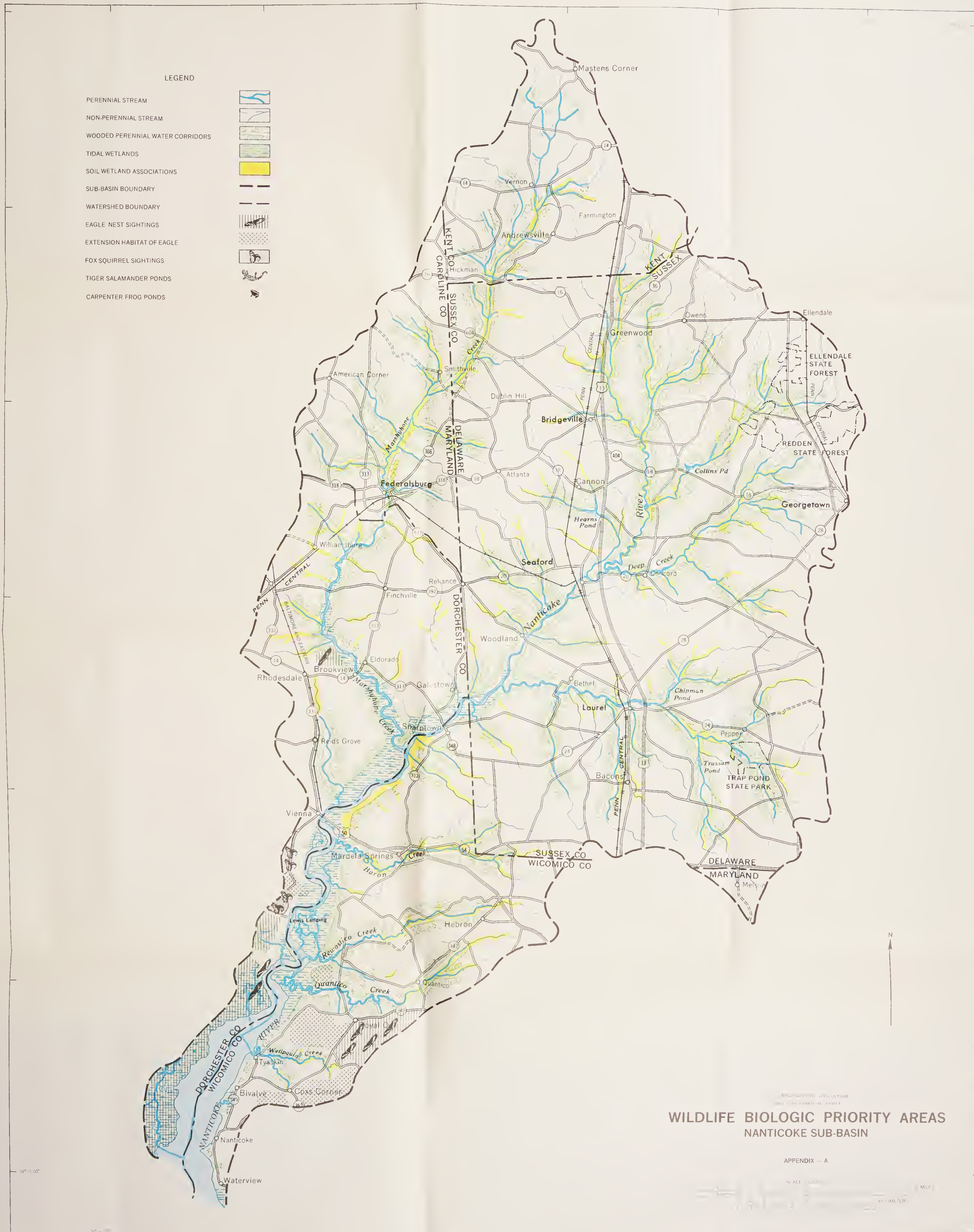

WILDLIFE BIOLOGIC PRIORITY AREAS

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182
Quinby
Mud
Parramore Island
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Willis Wharf
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Mud
Cobb Island
PENN CENTRAL
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Cobb Bay
Mud
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Cheriton
Oyster
Sand Shoal Channel
Wreck Island
Mockhorn Channel
SOUTH BAY
Mockhorn Island
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Ship Shoal Island
Godwin Island
Capeville
Mink Island
Townsend
Myrtle Island
Cedar Grove
Magothy Bay
Smith Island Bay
Smith Island
Kiptopeke
Skidmore Island
Cape Charles Lighthouse
CAPE CHARLES
Fishermans Island
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WILDLIFE BIOLOGIC PRIORITY AREAS
ATLANTIC SUB-BASIN
LOWER VIRGINIA WATERSHED
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SCALE
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LEGEND
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TIDAL WETLANDS
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PENN CENTRAL
Thompson
Higgins Millpond
Linkwood
Airey
Transquaking River
Salem
Bucktown
Green Brier Swamp
Towers Beach
Tower
Robbins
Andrews
Bestpitch
Chicamacomico River
Drawbridge
Creek
Island
Fishing Bay
Savanna Lake
ELLIOTT ISLAND
Elliott
N
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WILDLIFE BIOLOGIC PRIORITY AREAS
TRANSQUAKING SUB-BASIN
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USDA-SCS HYATTSVILLE, MD 1978


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WORCESTER CO
ACCOMACK CO
Greenbackville
CHINCOTEAGUE BAY
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ASSATEAGUE ISLAND
CHINCOTEAGUE N.W.R.
NATIONAL SEASHORE
Horntown
NASA Wallops Station
Chincoteague
Wattsville
Shelly Bay
Assateague Light
Assateague Island
Atlantic
Watts Bay
Powells Bay
Toms Cove
Bogues Bay
Wallops Island
Chincoteague Inlet
NASA (WALLOPS ISLAND)
Oyster Bay
Nelsonia
Modest Town
Gargathy Bay
Metomkin Island
Metomkin Bay
Daugherty
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Locustville
Melfa
Cedar Island
Wachapreague
Wachapreague Inlet
175
187
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U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
WILDLIFE BIOLOGIC PRIORITY AREAS
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CHINCOTEAGUE WATERSHED SOUTH
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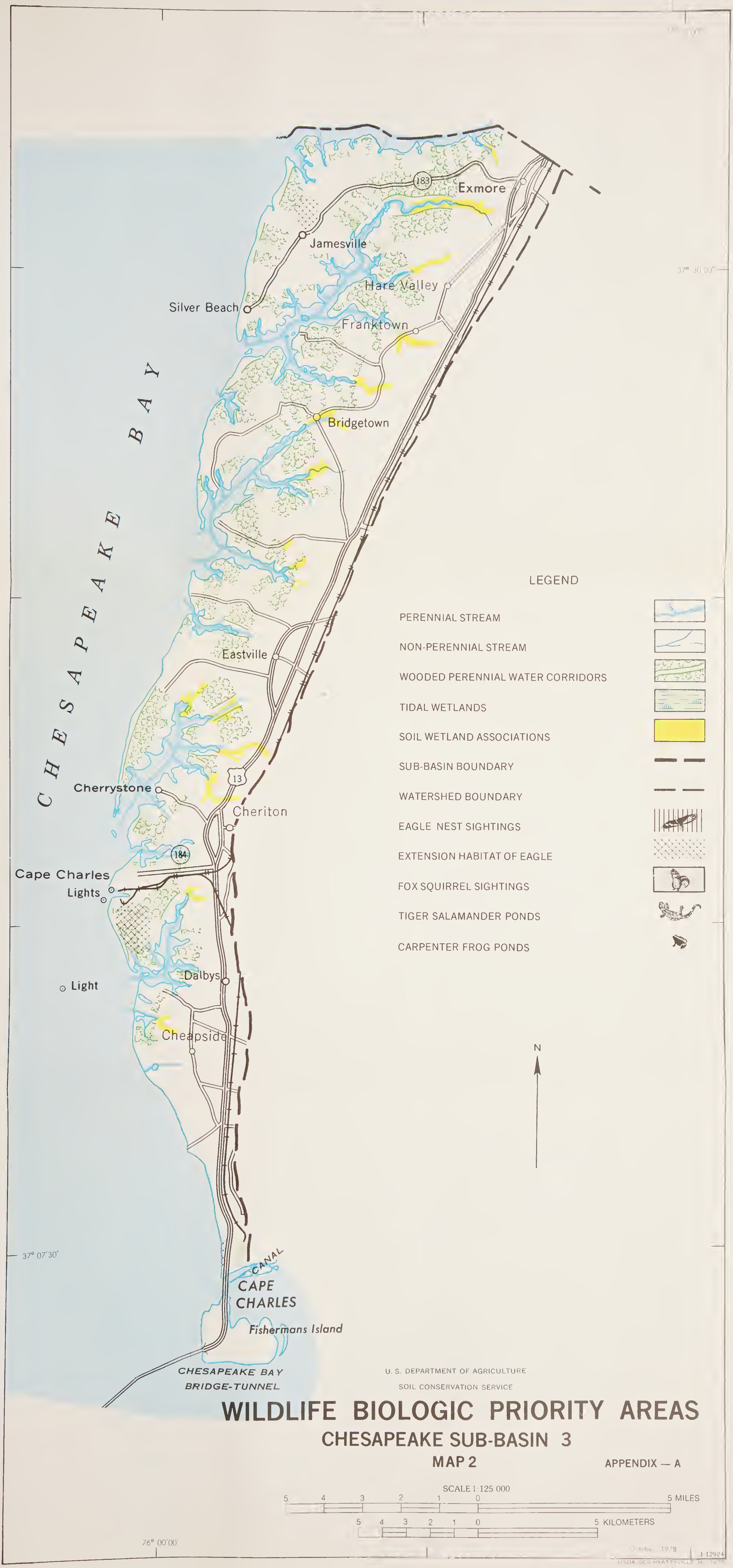

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SOIL CONSERVATION SERVICE

WILDLIFE BIOLOGIC PRIORITY AREAS

CHESAPEAKE SUB-BASIN 3

MAP 2

APPENDIX — A

October 1978

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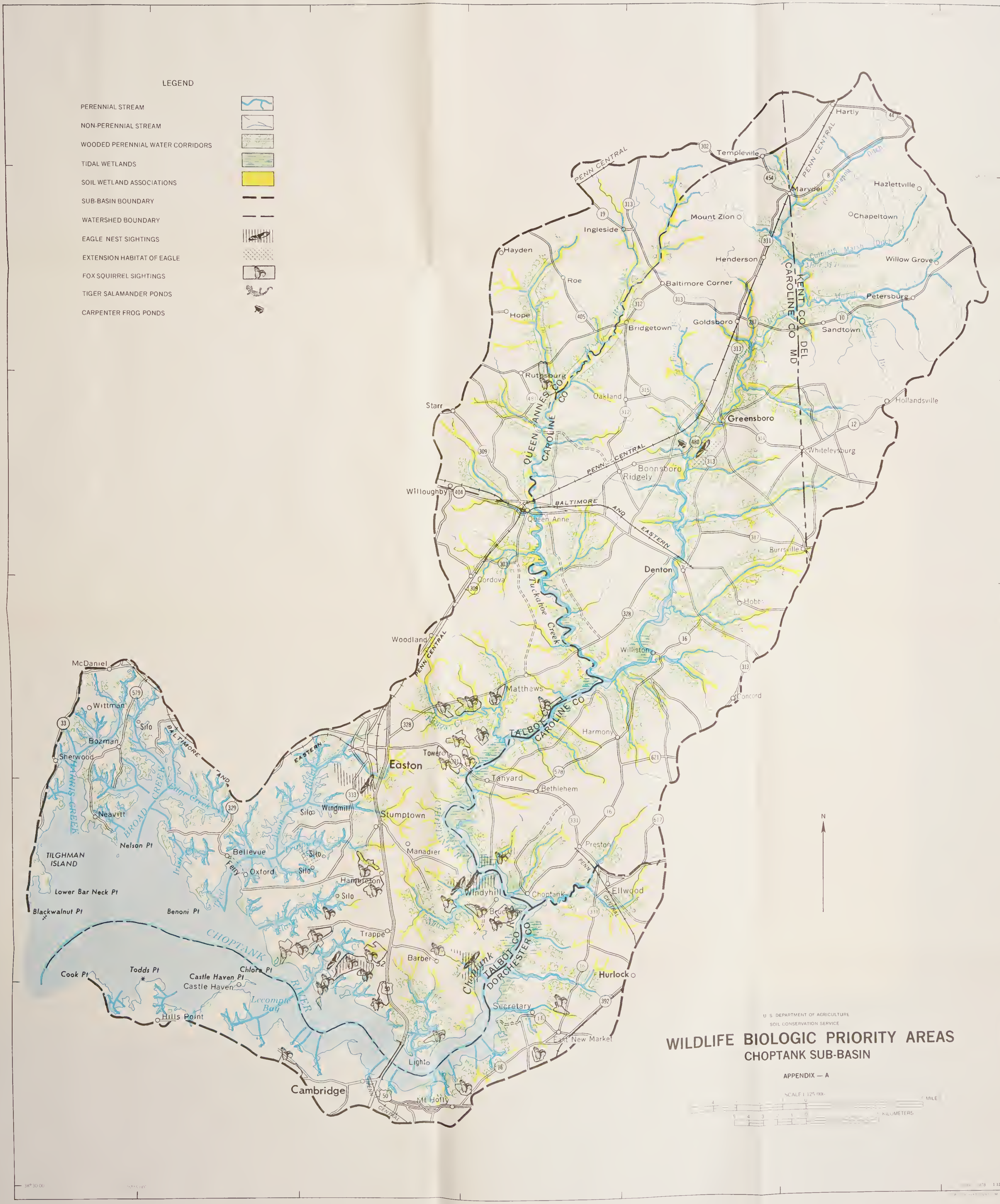
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SOIL CONSERVATION SERVICE
WILDLIFE BIOLOGIC PRIORITY AREAS
CHOPTANK SUB-BASIN
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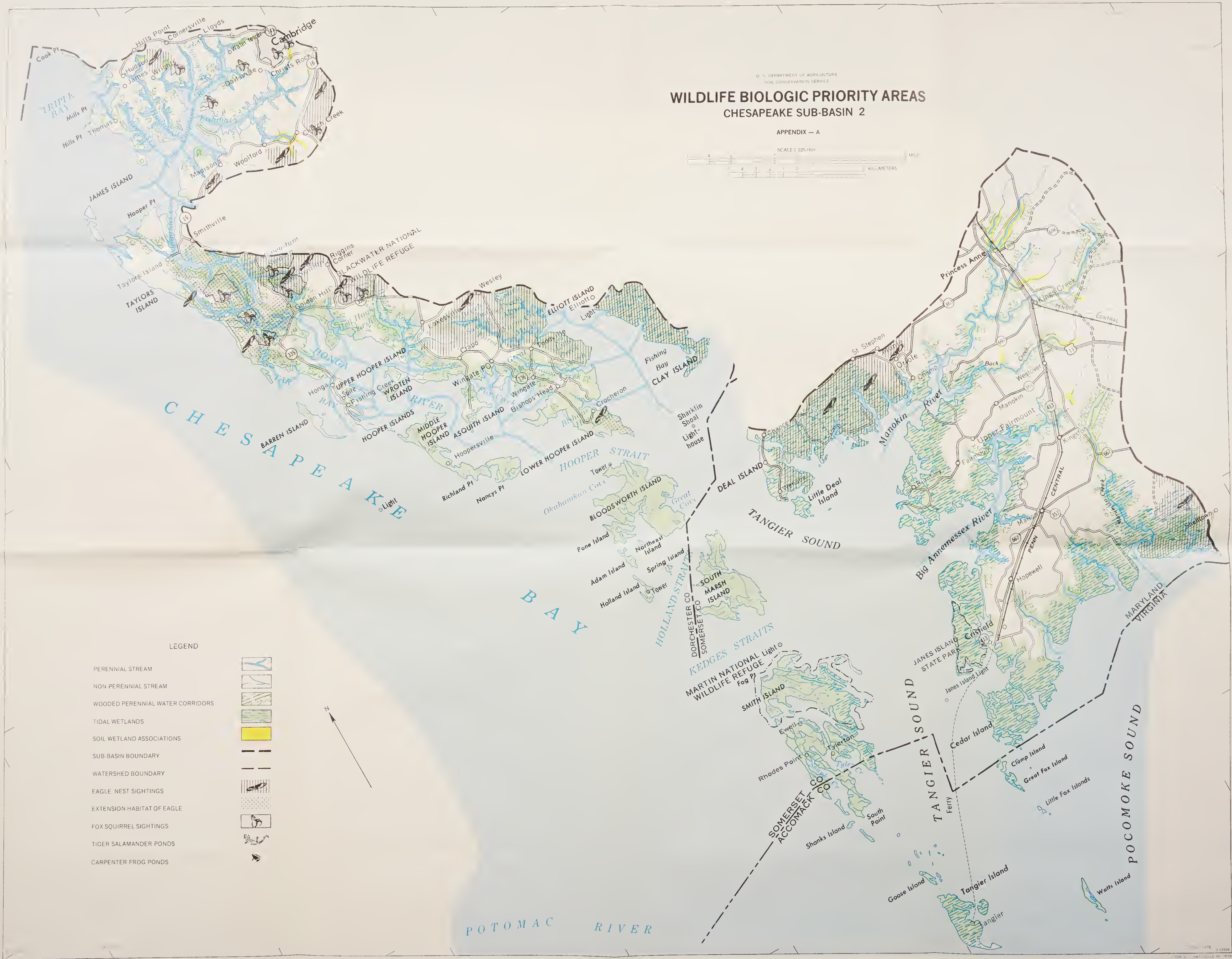
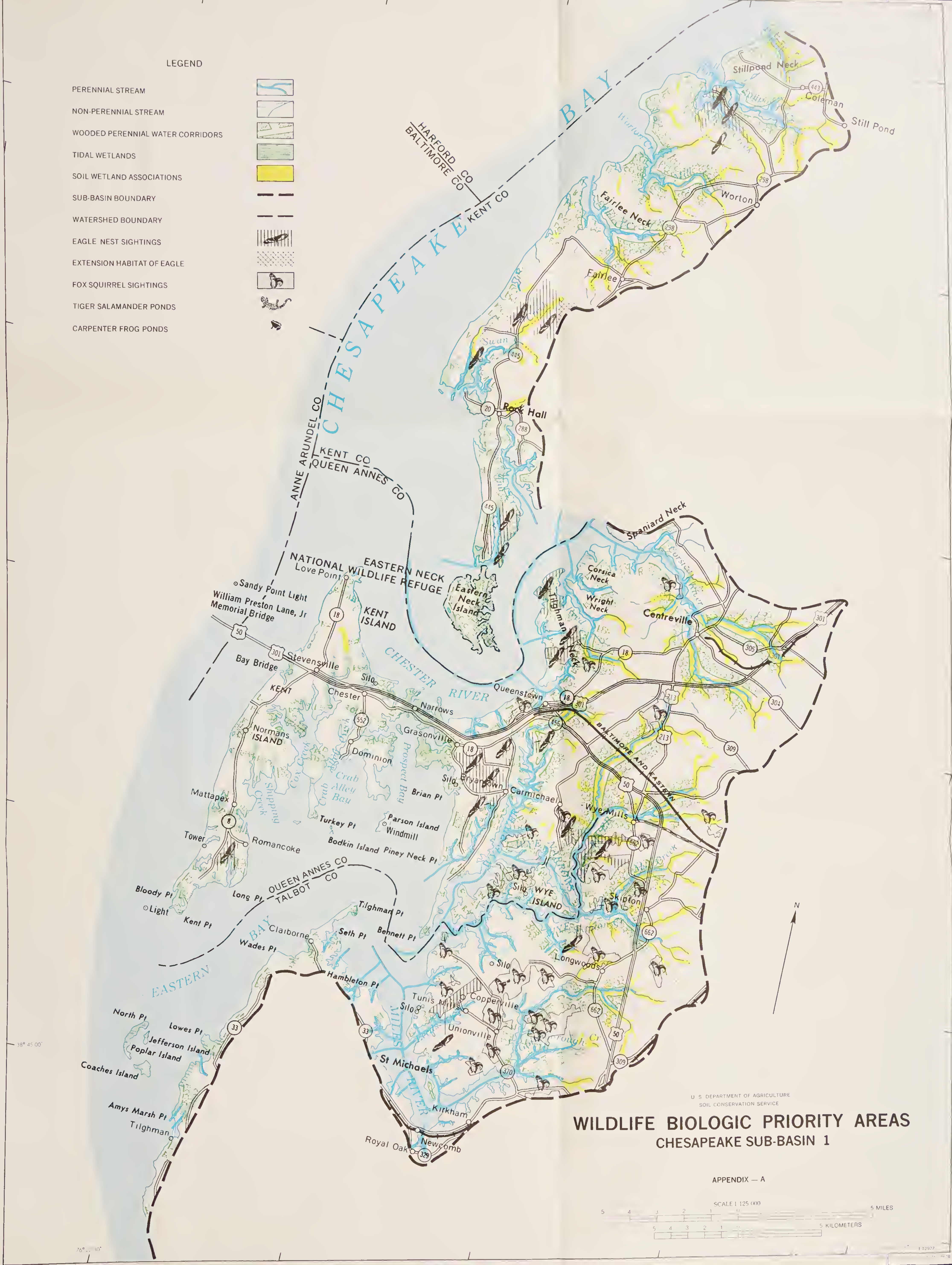
CAROLINE CO MD
QUEEN ANNES CO
CAROLINE CO
TALBOT CO
DORCHESTER CO
PENN CENTRAL
BALTIMORE AND EASTERN
Hartly
Templeville
Marydel
Hazlettville
Chapeltown
Mount Zion
Willow Grove
Henderson
Petersburg
Sandtown
Goldsboro
Baltimore Corner
Ingleside
Hayden
Roe
Hope
Bridgetown
Ruthsburg
Oakland
Starr
Hollandsville
Greensboro
Whiteleysburg
Boonsboro
Ridgely
Willoughby
Queen Anne
Burrsville
Denton
Cordova
Tuckahoe Creek
Hobbs
Woodland
Williston
Matthews
Concord
Harmony
Easton
Towers
Tanyard
Bethlehem
Stumptown
Windmill
Preston
Manadier
Ellwood
Windyhill
Choptank
Trappe
Hambleton
Barber
Hurlock
Secretary
East New Market
Light
Cambridge
Mt Holly
McDaniel
Wittman
Bozman
Sherwood
Silo
Neavitt
Nelson Pt
TILGHMAN ISLAND
Lower Bar Neck Pt
Blackwalnut Pt
Benoni Pt
Bellevue
Ferry
Oxford
Cook Pt
Todds Pt
Castle Haven Pt
Castle Haven
Chlora Pt
Hills Point
CHOPTANK RIVER
Lecompte Bay
BROAD CREEK
HARRIS CREEK



U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
WILDLIFE BIOLOGIC PRIORITY AREAS
CHESAPEAKE SUB-BASIN 2
APPENDIX — A
SCALE 1:125,000
MILES
KILOMETERS
LEGEND
PERENNIAL STREAM
NON PERENNIAL STREAM
WOODED PERENNIAL WATER CORRIDORS
TIDAL WETLANDS
SOIL WETLAND ASSOCIATIONS
SUB-BASIN BOUNDARY
WATERSHED BOUNDARY
EAGLE NEST SIGHTINGS
EXTENSION HABITAT OF EAGLE
FOX SQUIRREL SIGHTINGS
TIGER SALAMANDER PONDS
CARPENTER FROG PONDS
N
CHESAPEAKE
BAY
POTOMAC
RIVER
Cambridge
Cook Pt
Hills Point
Cornersville
Lloyds
Hudson
James
Wrights
Dorsyville
Christs Rock
Woolford
Madison
Thomas
Hills Pt
Mills Pt
TRIPPE BAY
JAMES ISLAND
Hooper Pt
Smithville
Taylors Island
TAYLORS ISLAND
Golden Hill
Riggins Corner
BLACKWATER NATIONAL WILDLIFE REFUGE
Wesley
Lakesville
ELLIOTT ISLAND
Elliotts
Light
Fishing Bay
CLAY ISLAND
Crapo
Wingate
Bishops Head
Crocheron
HONGA
RIVER
Honga
UPPER HOOPER ISLAND
Fishing Creek
WROTEN ISLAND
HOOPER ISLANDS
MIDDLE HOOPER ISLAND
ASQUITH ISLAND
Hoopersville
BARREN ISLAND
Richland Pt
Nancys Pt
LOWER HOOPER ISLAND
HOOPER STRAIT
Tower
BLOODSWORTH ISLAND
Pone Island
Northeast Island
Adam Island
Spring Island
Holland Island
HOLLAND STRAITS
SOUTH MARSH ISLAND
DORCHESTER CO
SOMERSET CO
Sharklin Shoal Light-house
DEAL ISLAND
Little Deal Island
TANGIER SOUND
KEDGES STRAITS
MARTIN NATIONAL WILDLIFE REFUGE
Fog Pt
SMITH ISLAND
Ewell
Tylerton
Rhodes Point
SOMERSET CO
ACCOMACK CO
South Point
Shanks Island
Goose Island
Tangier Island
Tangier
Ferry
TANGIER SOUND
Cedar Island
Clump Island
Great Fox Island
Little Fox Islands
Watts Island
POCOMOKE SOUND
JANES ISLAND STATE PARK
Janes Island Light
Crisfield
Big Annemessex River
Manokin River
St. Stephen
Oriole
Princess Anne
Kings Creek
Back Creek
Westover
Manokin
Upper Fairmount
Fairmount
Kingston
Marion
Hopewell
Shelltown
PENN CENTRAL
MARYLAND
VIRGINIA


LEGEND
PERENNIAL STREAM
NON-PERENNIAL STREAM
WOODED PERENNIAL WATER CORRIDORS
TIDAL WETLANDS
SOIL WETLAND ASSOCIATIONS
SUB-BASIN BOUNDARY
WATERSHED BOUNDARY
EAGLE NEST SIGHTINGS
EXTENSION HABITAT OF EAGLE
FOX SQUIRREL SIGHTINGS
TIGER SALAMANDER PONDS
CARPENTER FROG PONDS
CHESAPEAKE BAY
HARFORD CO
BALTIMORE CO
KENT CO
ANNE ARUNDEL CO
QUEEN ANNES CO
TALBOT CO
Stillpond Neck
Coleman
Still Pond
Worton
Fairlee Neck
Fairlee
Rock Hall
Spaniard Neck
Corsica Neck
Wright Neck
Centreville
Tilghman Neck
Eastern Neck Island
EASTERN NECK NATIONAL WILDLIFE REFUGE
Love Point
Sandy Point Light
William Preston Lane, Jr Memorial Bridge
KENT ISLAND
CHESTER RIVER
Queenstown
Bay Bridge
Stevensville
Silo
Chester
KENT
Narrows
Grasonville
Dominion
Prospect Bay
Crab Alley Bay
Cox Creek
Shipping Creek
Normans ISLAND
Mattapex
Tower
Romancoke
Turkey Pt
Parson Island
Windmill
Brian Pt
Bodkin Island
Piney Neck Pt
Bryantown
Carmichael
BALTIMORE AND EASTERN
Wye Mills
WYE ISLAND
Skipton
Longwoods
Bloody Pt
Light
Long Pt
Kent Pt
Tilghman Pt
Bennett Pt
Seth Pt
Claiborne
Wades Pt
EASTERN BAY
Hambleton Pt
Tunis Mills
Copperville
Unionville
St Michaels
MILES RIVER
Kirkham
Newcomb
Royal Oak
North Pt
Lowes Pt
Jefferson Island
Poplar Island
Coaches Island
Amys Marsh Pt
Tilghman
N
U S DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
WILDLIFE BIOLOGIC PRIORITY AREAS
CHESAPEAKE SUB-BASIN 1
APPENDIX — A
SCALE 1:125,000
5 MILES
5 KILOMETERS

LEGEND
PERENNIAL STREAM
NON-PERENNIAL STREAM
WOODED PERENNIAL WATER CORRIDORS
TIDAL WETLANDS
SOIL WETLAND ASSOCIATIONS
SUB-BASIN BOUNDARY
WATERSHED BOUNDARY
EAGLE NEST SIGHTINGS
EXTENSION HABITAT OF EAGLE
FOX SQUIRREL SIGHTINGS
TIGER SALAMANDER PONDS
CARPENTER FROG PONDS
75° 30'00"
38° 00'00"
MD
VA
SOMERSET CO
ACCOMACK CO
Saxis
Grotons
Horsey
238
Hallwood
PENN CENTRAL
BEASLEY
BAY
187
Bloxom
Halfmoon Island
Hopkins
Parksley
176
316
Deep Creek
Tobacco Island
Chesconessex
Greenbush
Accomac
Onancock
Creek
Onancock
Tasley
Onley
N
178
Parkers Island
Cashville
Finneys Island
Scarborough Island
Accomack Co
Harborton
Melfa
180
Hacksneck
Pungoteague
180
Keller
Nandua Creek
37° 37'30"
178
Painter
Craddockville
Belle
Haven
13
Occohannock
Creek
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
WILDLIFE BIOLOGIC
PRIORITY AREAS
CHESAPEAKE SUB-BASIN 3
MAP 1
APPENDIX — A
SCALE 1:125 000
5 4 3 2 1 0 5 MILES
5 4 3 2 1 0 5 KILOMETERS
75° 52'30"
October 1978 1-12928
USDA SCS HYATTSVILLE MD 1978

APPENDICES

DELMARVA RIVER BASINS SURVEY

COOPERATIVE RIVER BASIN SURVEY

BY

THE UNITED STATES DEPARTMENT OF AGRICULTURE
IN COOPERATION WITH
THE MARYLAND DEPARTMENT OF NATURAL RESOURCES
THE MARYLAND DEPARTMENT OF AGRICULTURE
THE DELAWARE DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENTAL CONTROL

THE VIRGINIA SOIL AND WATER CONSERVATION COMMISSION

OCTOBER 1978

Cover: Characteristic of the Delmarva Peninsula's rural areas, cropland and pastureland, poultry houses, well-kept farm houses, woodland, domestic animals and wildlife offer a tranquil, peaceful setting. This scene was drawn by C. Dwayne Jones, Soil Conservation Associate for Wicomico County Soil Conservation District.

APPENDICES

DELMARVA RIVER BASINS
COOPERATIVE SURVEY

WATER AND LAND RESOURCES

Prepared by

UNITED STATES DEPARTMENT OF AGRICULTURE
ECONOMICS, STATISTICS, AND COOPERATIVES SERVICE
FOREST SERVICE
SOIL CONSERVATION SERVICE

in cooperation with
the States of
MARYLAND, DELAWARE, VIRGINIA

OCTOBER 1978

INTRODUCTION

The DELMARVA RIVER BASINS SURVEY was made under the authority of Section 6 of the Watershed Protection and Flood Prevention Act (Public Law 83-566, as amended and supplemented).

The main report is published in a separate volume. It contains an assessment of present and future conditions, a description of basin problems and needs, a presentation of alternative solutions (NED and EQ), a suggested alternative to satisfy the needs and opportunities for implementation.

These Appendices supplement the main report.

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SOCIO-ECONOMIC BASE REPORT

APPENDIX B

FOREWORD

The Delmarva River Basins Cooperative Survey involves the participation of Federal and State agencies in a coordinated study of water and related land resource problems on the Delmarva Peninsula. The Economics, Statistics, and Cooperatives Service (ESCS), as a participating agency of the United States Department of Agriculture, has been assigned to conduct economic analyses in support of the objectives of the survey and to collect and tabulate secondary data pertaining to the Peninsula's population, economy, and use of land and water resources. This appendix is intended for distribution to participating Federal and State agencies to provide a common reference for social and economic data collected in the initial and succeeding phases of the survey. Included are a brief history of the Peninsula and descriptions of the Peninsula's population, general economy, agriculture, land use, and water use along with supporting data descriptive of current conditions and recent trends. Additional appendices present the results of detailed analyses of economic conditions on the Peninsula today and of conditions expected to prevail in the future.

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SOCIO-ECONOMIC BASE REPORT: DELMARVA RIVER BASINS COOPERATIVE SURVEY

by

Kenneth S. Krupa*
James E. Horsfield*

INTRODUCTION

This socio-economic base report contains historical data for the use of participants in the Delmarva River Basins Cooperative Survey. The agencies of the United States Department of Agriculture (USDA) assisting in this survey are the Economics, Statistics, and Cooperatives Service (ESCS), Soil Conservation Service, and the Forest Service. These agencies are participating in the survey at the requests of the states of Delaware, Maryland and Virginia. The purpose of this report is to provide a general overview of the social, political, and economic conditions existing within the survey area and to serve as a basic point of reference for a series of more specialized reports.

The objective of the entire series of reports -- inventorying existing resources, documenting past economic trends, and presenting future projections -- is to provide detailed information to aid policy makers in planning for the orderly development, utilization, management, and conservation of water and related land resources within the survey area. These reports provide a base upon which to formulate a plan of action to promote economic growth, control development, and provide for environmental enhancement in the Peninsula area.

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*Economists, USDA, ESCS, Natural Resource Economics Division, Broomall, PA.

This particular report contains a history of the socio-economic development of the Peninsula and a summary analysis of the region's population, economy, and agriculture. Additional sections discuss current land and water uses. Principal sources of data for the report were the Census of Population, Census of Agriculture, Census of Manufacturing, state agency reports, and previous studies of the region. Additional data was provided by the Bureau of Economic Analysis, United States Department of Commerce.

Geography and Climate

Figure A is a map of the Delmarva River Basin survey area. Since the northern boundary of this area is located at the Chesapeake and Delaware Canal, portions of Cecil County, Maryland and New Castle County, Delaware, are included in the survey area.[1/] In addition, the survey area encompasses two counties in Delaware (Kent and Sussex) eight counties in Maryland (Kent, Queen Annes, Talbot, Caroline, Dorchester, Wicomico, Somerset, and Worcester) and two counties in Virginia (Accomack and Northampton).

The Delmarva Peninsula is approximately 174 miles from north to south and at the widest point is 74 miles from east to west. The region, encompassing a 7,500 square mile area, contains approximately 3,565,000 acres of land and 1,282,000 acreas of various types of water.

Topographically, the Delmarva Peninsula is relatively flat - especially along the coast and nearshore - with gently rolling hills located in some inland areas. Surface elevations range from zero to 310 feet above sea level. However, the vast majority of land area is less than 80 feet above sea level.

1/ Census data in this report includes totals from Cecil County, Maryland, and New Castle County, Delaware. Data provided by the Bureau of Economic Analysis, however, is for the twelve-county area excluding Cecil and New Castle counties.


PENNSYLVANIA
NEW JERSEY
MARYLAND
VIRGINIA
DELAWARE BAY
CHESAPEAKE BAY
CHESTERTOWN
CENTREVILLE
DOVER
DENTON
Milford
Milton
EASTON
GEORGETOWN
Rehoboth Beach
Seaford
Laurel
CAMBRIDGE
SALISBURY
Ocean City
PRINCESS ANNE
SNOW HILL
ACCOMAC
EASTVILLE
Cape Charles
Fishermans
KENT
SUSSEX
CAROLINE
WICOMICO CO
WORCESTER CO
ACCOMACK CO
DELAWARE
MARYLAND
VIRGINIA
ATLANTIC OCEAN
TANGIER SOUND
POCOMOKE SOUND
INTRACOASTAL WATERWAY
Smith Island
Tangier I
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
FIGURE A
DELMARVA RIVER BASINS SURVEY
KENT, NEW CASTLE, AND SUSSEX COUNTIES, DELAWARE
CAROLINE, CECIL, DORCHESTER, KENT, QUEEN ANNES, SOMERSET, TALBOT, WICOMICO, AND WORCESTER COUNTIES, MARYLAND
ACCOMACK, AND NORTHAMPTON COUNTIES, VIRGINIA
20 Miles
SOURCE USGS MAP SHEETS 1 250,000
October 1974

From a geological perspective, the area of the Peninsula south of the Chesapeake and Delaware Canal is located entirely within the Coastal Plain. The soil structure of the Coastal Plain contains sedimentary layers of sand, silt, gravel, and clay resting on a base of hard crystalline rock. Surface soils - which span the range from sandy to clayish - tend to be slightly acidic in nature.

The Delmarva Peninsula is located on the mid-Atlantic seaboard of the Eastern United States between 37 and 40 degrees north latitude. The region has a basically temperate climate with four well defined seasons. Weather systems generally approach from the west as in most areas of the continental United States.

The climate is relatively moderate with plenty of sunshine, abundant precipitation, and a long growing season. Proximity to the Chesapeake Bay and the Atlantic Ocean, to a lesser extent, has a modifying influence on the climate. Average yearly temperatures range from 54° to 59° F. January has traditionally been the coldest month with average minimum daily temperatures ranging between 27° and 29°. July is usually the warmest month with average maximum daily temperatures between 86° and 88°.

In the extreme northern section of the Peninsula the frost free period normally extends from late April to early October. This period between the last 32°F temperature in the Spring and the Fall, the growing season, generally averages 181 days. On the southern tip of the Peninsula the frost free dates normally extend from late March through mid-November with the growing season generally averaging 203 days.

Precipitation usually ranges from 40 to 46 inches per year including 10 to 13 inches of snow. However, the atmosphere reclaims through evaporation

from land, water, and plant sources sixty percent (or 26 inches) of the annual precipitation total. The amount and frequency of precipitation have created some agricultural water distribution problems within the Peninsula. Many low lying fields are in need of drainage to improve crop yields. For sandy soil during dry periods irrigation is sometimes necessary to supply moisture to crops at critical stages of development.

General Description

The level to gently rolling coastal plains of the Delmarva Peninsula are deeply incised by streams and tidal estuaries. The Peninsula is almost entirely surrounded by tidewater and the shoreline is irregular with numerous bays and inlets. The three bodies of water surrounding the Peninsula are: the Chesapeake Bay to the west, Delaware Bay to the east, and the Atlantic Ocean to the east-southeast.

Dividing the narrow northern end of the Peninsula is the Chesapeake and Delaware Canal. The eastern portion of the canal is located in the State of Delaware and the western portion lies in the State of Maryland. The canal connects the Chesapeake Bay and the Delaware River and is a demarcation line between the Boston-Washington megalopolis and the rural environment of the Peninsula.

To the north are the cities of Wilmington and Philadelphia while to the south small towns, farmland, and woodland predominate. For generations the mainstreams of industry and commerce have tended to bypass the Delmarva area in favor of such nearby "mainland" centers as Philadelphia, Wilmington, and Baltimore. Consequently, the Delmarva Peninsula has remained an exclusively rural and small town region although the agricultural, industrial,

and seafood products of the area are largely oriented towards nearby urban markets.

Within the Peninsula there is a northern (upper) and southern (lower) area. The land in the lower portion is flatter than that in the upper portion. While both sections are dependent upon farming, fishing, and small to medium scale manufacturing, the lower sector is more highly urbanized, has more truck farming, and does a considerably greater amount of food processing.

The word "Delmarva" is a derivation of names of three states--Delaware, Maryland, and Virginia--that share jurisdiction over the Peninsula. The Delmarva Peninsula is unique in two respects. First, it is the only peninsula in the United States divided among three states. Second, the official state boundaries within the Peninsula are artificial, as opposed to being natural barriers--such as mountains, rivers, or other bodies of water. The reason for the unique political subdivision of the area can only be explained by reviewing the history of the Delmarva Peninsula--frequent site of territorial disputes between sovereign states seeking control over the vast and varied resources of the area.

History

The Algonquian Indians were the first inhabitants of the Chesapeake Bay region. Much of the area still bears the Indian names of Assateague, Sinepuxent, and Chincoteague. Even the name "Chesapeake" is thought to be a derivation of the Indian word K'Che-sipiah meaning country on a great river.

The first documented European contact occurred in 1608 when an expeditionary force under the direction of Captain John Smith explored much of the Chesapeake Bay area. Less than a decade later settlers from the Virginia Colony began populating the southern tip of the Peninsula. While

the English were exploring and settling the southern portion of the Peninsula the Swedes were exploring and establishing settlements in the northern part. The major Swedish enclave was located on the site of the present-day city of Wilmington, Delaware.[1/]

Other Europeans were eager to explore and colonize the rich new world. Numerous skirmishes and battles were waged for control of land and colonies. The Dutch, anxious to extend their influence from New Amsterdam (New York), fought and defeated the Swedes in Delaware. The Dutch leader, Governor Peter Stuyvesant, renamed the area New Amstel. The Dutch were industrious in their agricultural pursuits; made numerous internal improvements including the digging of canals and the diking of marshes; and developed the settlement of New Amstel into a prosperous marketing center. Dutch influence lasted about nine years. In 1664, King Charles II of England suggested that his brother - James, Duke of York - organize a military expedition to wage war against the Dutch colonies. In 1665 both New Amsterdam and New Amstel were captured, placed under the administrative supervision of the Duke of York, and renamed New York and New Castle.

Sections of Delaware were long regarded as part of Maryland by the House of Calvert - colonial rulers of the Free state. In a bold attempt to strengthen the Calvert claim, the Provincial Council in 1669 directed that two additional counties - with allegiance to Maryland - be created in the Delaware territory. A bitter dispute ensued between the Calverts and James, Duke of York.

In 1672, the controversy was presented before the Privy Council of London

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1/ Historical facts and dates were derived from Community Economic Inventories, Maryland Department of Economic Development and Economic Data Summary, Division of State Planning and Community Affairs (Accomack and Northampton counties, Virginia).

for adjudication, the matter taken under consideration, and deliberated upon for over thirteen years. During the course of the deliberation, James, Duke of York, ascended the throne of England as King James II. In 1682, King James II ceded the land in controversy, the three counties of Delaware, to William Penn - Founder of Pennsylvania. No doubt influenced by the fact that one of the litigants was the reigning monarch of England, the Council handed down a ruling in 1685 to the effect that the disputed territory belonged to the Crown and not to Maryland.

In 1704, William Penn permitted the three counties of Delaware to form a separate colonial government. Under terms of the agreement, Delaware residents were granted the right to establish entirely free and separate Legislative and Judicial branches of government. However, Executive power was to be retained by Pennsylvania authorities. For over seven decades - until 1776 - the Governor of Pennsylvania remained the chief Executive officer of the colony of Delaware.

Territorial disputes, especially between Penn and Calvert descendants, continued in the area until 1768 when a five year survey of the boundaries by two English mathematicians, Charles Mason and Jeremiah Dixon, was completed. The survey, settling all disputes, established the boundary lines between Maryland, Pennsylvania, and Delaware. Later, during the Civil War, the Mason-Dixon Line was to become the symbolic dividing line between the North and the South.

Toward the latter part of the Eighteenth Century the town of Wilmington became sufficiently populated to warrant the building of a town hall and the chartering of a bank. During this period, the states of Maryland and Delaware approved construction of the Chesapeake and Delaware Canal. Officially opened in 1829, the Canal provided a shipping route from Philadelphia

and Wilmington to Baltimore, Virginia, and the rest of the Chesapeake Bay. While the section north of the Chesapeake and Delaware Canal gradually became part of a large urban complex, the area south of the Canal remained primarily rural and agricultural. Geographically, the rural, agricultural section of the Peninsula was separated by water from the northern, urban section and bypassed when the great westward flow of immigration occurred during the 1800's. For three hundred years the Peninsula was relatively isolated. Access from the mainland and from the large population centers was by ferry or by secondary roads from the North. Construction of the Bay Bridge connecting Annapolis with Queen Anne's County, Maryland, in 1952 (and a parallel span completed in 1972) provided a major east-west link between the Baltimore - Washington urban complex and the Delmarva Peninsula. In 1964 construction was completed on the Chesapeake Bay Bridge - Tunnel, a major north-south artery connecting the Norfolk - Portsmouth metropolitan area with Northampton County, Virginia on the southern tip of the Peninsula. The bridge - tunnel, which transverses the Chesapeake Bay for twenty-one miles, is the longest bridge-tunnel in the world.

Chesapeake Bay[1/]

Chesapeake Bay is the largest estuary on the Atlantic Coast of the United States and including its tributaries is one of the largest estuarine systems on earth. The bay runs in a north-south direction for two hundred miles and is roughly parallel to the Atlantic Coast. At the southern extreme it is freely connected with the Atlantic Ocean. The width of the bay varies from

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1/ This section is a summary of the description and the problems of the Chesapeake Bay.

Sources: The Chesapeake Bay Plan of Study (Volume I, pages 7-10, June of 1970) and Chesapeake Bay Future Conditions Report (Volume I, Summary, August of 1977).

four miles wide at Annapolis to thirty miles wide at the mouth of the Potomac River. The depth averages twenty-one feet but there are deep holes which occur as long narrow troughs. These troughs are thought to be remnants of the Ancient Susquehanna River Valley which have not been filled by post-Pleistocene sediments.

Chesapeake Bay is entirely within the Atlantic Coastal Plain. The coastal plain is underlain by a thick, wedge-shaped series of sedimentary formation which strikes northeast and dips gently toward the southeast.

The mean tidal fluctuation of the bay is small, generally between one and two feet. Saline water intrusion is highest along the eastern shore due to the influence of the Atlantic Ocean. Salinities range from 35 parts per thousand inside the mouth of the bay to near zero at the northern end of the bay and at the heads of embayments tributary to the bay. Salinity variations, spatial and temporal, are the most significant physical charateristics influencing the circulation patterns of the estuary.

Average maximum tidal currents range from .05 to over three knots. The tidal currents supply the means for the mixing of ocean and fresh water. Non-tidal circulation in the smaller tributaries of the bay is controlled by the temporary variations of salinity in the bay. Salinity decreases in the bay during winter and early spring. Salinity in the smaller tributaries is greater than in the bay during this period. Because of the significant salinity difference, surface water from the bay flows into the tributaries, while bottom water from the tributaries flows into the bay. As bay salinity becomes greater through summer and early fall, bay waters flow into the bottom of the tributaries, while tributary surface waters flow into the bay.

The physical and chemical dynamics of the estuary make it a biologically unique environment. Salinity variations within the Chesapeake Bay have

allowed colonization by aquatic organisms of both fresh and salt water origins. Fresh water biota remain in the fresh or slightly brackish water portions. Many marine animals return to fresh water to reproduce. With the aid of estuarine currents, the eggs and larval forms of some species are transported to less saline water to hatch or develop.

Chesapeake Bay, because of its great length of shoreline and its extensive shallows, weed beds, and marshes, protects as well as nourishes larval and juvenile animal forms from immediate predation and wave action. The marshes of the bay generate organic debris and animal nutrients, constituting a significant factor in the overall estuarine productivity.

Chesapeake Bay produces large crops of estuarine species. The most important economically are the soft-shelled clam, oysters, blue crabs, menhaden, and alewives. Many of the 238 recorded fish species are permanent residents. Shad and river herring spawn at the headwaters. Striped bass and white perch produce large populations in the nearly fresh water of the upper bay to spread throughout the bay. Many ocean spawners use the bay as a nursery for their young. A wide variety of oceanic species enter the bay as juveniles or adults to feed.

Between 1966 and 1970, an average of 281 million pounds of commercial seafood, valued at more than $30 million annually, was harvested from the Chesapeake Bay. The average finfish catch - primarily menhaden and alewife - amounted to 243 million pounds worth $3.7 million. During the same time period the average harvest of shellfish (crabs, oysters, and clams) totaled 88 million pounds (excluding shell weight) worth over $23 million. Though accounting for over 24 percent of the total seafood harvest, shellfish generated 78 percent of total revenue.

In 1973, the composition of the seafood harvest differed somewhat. The commercial harvest of certain types of finfish - alewife and perch - declined markedly from the 1970 level. However, commercial fishermen netted unexpectedly large numbers of bluefish, sea trout, and croakers. Commercial shellfish harvests in 1973 were of comparable magnitude to harvests of 1966-1970 in terms of both weight and value. Clams, and to a lesser extent crab catches, in both states decreased considerably from previous years due to the disruptive effects of Tropical Storm Agnes.

While the 1973 oyster harvest in Maryland was the largest in 30 years, in Virginia the oyster catch was the lowest on record due to a poor reproduction rate, disease, and adverse weather conditions.[1/] In 1975, oysters landed commercially at ports on the Eastern Shore of Maryland amounted to 13,401,000 pounds (not including shell weight) worth $10,780,590. During the same year, 748,100 pounds of oysters valued at $551,930 were harvested in the waters adjacent to Accomack and Northampton counties, Virginia. It should be noted that the dollar value was that paid at the dock, not the wholesale or retail value at market, and that the figures are only for commercial oysters harvested on the Delmarva side of the Chesapeake Bay. Data for 1976 indicates that 9,047,800 pounds valued at $9,611,732 and 1,320,400 pounds worth $985,717 were landed at ports in the same areas of Maryland and Virginia, respectively. Interestingly, Talbot County, accounting for approximately 5 million pounds in 1976, registered the largest oyster harvest of all Peninsula counties during the 1975-1976 period.

A significant quantity of finfish were landed by sport fishermen whose value may equal or exceed that of the commerical operators. In addition, a

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1/ Chesapeake Bay Future Conditions Report, (Volume I, Summary, August of 1977), pages 90-95.

number of clams, oysters, and crabs were harvested by individuals for recreational or personal uses. These sport fishing, shellfishing, and boating activities contributed significantly to the tidewater way of life cherished by many residents and non-residents alike.

In 1974, waterborne commerce, totaling approximately 160 million short tons, moved over the waterway and contributed, in large measure, to the economy of an eleven-state area extending into the Midwest. The trend in commercial navigation is toward larger ships which in turn require deeper channels, posing greater problems in locating dredge spoil disposal areas. Modifying channel geometry may cause increases in upstream salinity, and indiscriminate disposal of spoil can have marked effects on living marine organisms.

Delaware Bay

Delaware Bay is in the shape of a flattened funnel - narrow at the northwestern terminus but widening to the southeast as the mouth joins the Atlantic Ocean. The bay, which lies between Cape May, New Jersey, to the north and Cape Henlopen, Delaware, to the south, is forty-six statute miles in length and twenty-seven miles at the most extreme width. Total shore line is 128 miles and the average depth is 31 feet with the maximum depth being 151 feet. Delaware Bay is shallow on the eastern (New Jersey) side and although deeper on the western (Delaware) side, a forty foot channel has been dredged to allow for the large ships that ply the bay towards the ports of Philadelphia, Baltimore, Wilmington and Trenton.

There are many similarities between the Delaware and Chesapeake bays. Both are located within the coastal plain; both have varying degrees of salinity that allow for aquatic organisms from both fresh and salt water

origins; both attract ocean spawners to feed and lay their eggs; and both provide an environment for the clam, oyster, blue crab, and menhaden. While Delaware Bay is smaller in area, the level of pollution is relatively greater than in the Chesapeake Bay. The Delaware River, which flows past Trenton, Philadelphia, Camden, and Wilmington deposits substantial amounts of partially treated sewage and industrial waste into Delaware Bay. Pollution concentrations within the bay have reduced recreational opportunities with many areas being closed to shellfishing and swimming.

An assessment of the situation between 1973 and 1978 indicates that the level of pollution did not change appreciably - remaining the same or experiencing a very modest improvement - from previous periods. Under the direction of the Federal Environmental Protection Agency progress was made in curing industrial pollution - especially in the Philadelphia area - during the five year period. Due to the large population and massive concentration of industrial concerns along the Delaware River, returning the water to a relatively pure form is a formidable task. However, it is expected that steady progress will be made in returning the Delaware River to a much improved state over the next several decades.

Commercial fishing, once a major enterprise on the bay, has declined because of disease, pollution, and economics. The oyster industry is an illustration of this decline - once a rich and abundant harvest, most oysters were harvested from natural beds. In the twelve year period from 1946 to 1957, only 686,000 bushels of oysters were planted but over 2,961,000 bushels were harvested. In 1950 most of the young oysters were killed by a disease called MSX and by 1960 the natural beds were barren.

The annual number of oysters harvested from Delaware Bay since 1950 has

varied considerably. In 1953 - a year of recovery - the oyster catch was valued at $2,750,000. In 1963, a year of appreciable decline, the value of the harvest was only $30,000. In 1975, 195,000 pounds (excluding shell weight) of oysters valued at $226,750 were landed at Delaware ports. It should be noted that monetary value in 1975 and 1976 was that paid to oystermen directly, not the wholesale or retail price and that the poundage included only oysters harvested by commercial oystermen in New Castle, Kent, and Sussex counties - not including the New Jersey shore of the Delaware Bay. In 1976, 262,300 pounds of oysters with a value of $380,700 were harvested by Delaware oystermen.

The aesthetic quality of the bay has declined but it remains a major waterway. During 1972 approximately 64 million tons of international water-borne commerce traveled the bay destined for the ports of Philadelphia, Baltimore, Wilmington, and Trenton.

Transportation

The major transportation system within the Delmarva Peninsula is U.S. Highway 301. This is a dual highway and a north-south through route extending from the New Jersey turnpike across the Chesapeake Bay Bridge and thence southward to Florida. The Chesapeake Bay Bridge connects the Eastern and Western Shores of Maryland on Routes 50 and 301, forming an important link in the Peninsula's transportation system. Another dual highway, Highway 50, serves as the principal Maryland gateway to the Peninsula in addition to being an important connector between the Peninsula and Washington, D.C. and major interstate highways to the west and south.

Highway U. S. 13 is the major north-south divided highway that offers a rapid route from Wilmington south to the Bay Bridge-Tunnel. Since the

construction of the Bay Bridge-Tunnel the peninsula serves as a transportation corridor between Wilmington, Norfolk and points south and west. Several trucking lines serve the area and provide twenty-four hour service within a three hundred mile radius that encompasses the Boston to Washington, D.C. megalopolis.

In April of 1976 Conrail (Consolidated Rail Corporation) was created as part of a national reorganization of the railroad system in the Northeastern United States. Conrail, under the auspices of the Federal Government, acquired several sections of former Penn Central Railroad track and in 1978 operated two main freight, but no passenger, lines on the Delmarva Peninsula. One line provides north-south service from Wilmington through Salisbury, where there are several industrial spur lines, to the vicinity of Pocomoke City in southwestern Worcester County. The other major trunk line extends east from Harrington, in southwestern Kent County (Delaware) then south to Snow Hill in central Worcester County, Maryland.

Conrail freight trains operate once a day, five days a week, between Dover and Pocomoke City. Rail service between Harrington and Snow Hill is two to three times per week. The frequency of industrial spur service is largely determined on the basis of need. In mid-1978 Conrail was in the process of investing modest amounts of capital on the Peninsula to maintain the road bed and increase rail efficiency.

Several sections of the former Penn Central Railroad, not acquired by Conrail, were leased to private enterprises, or a combination of state, local, and private concerns, and provide additional rail service on the Peninsula. The Virginia and Maryland Railroad supplements the basic Conrail north - south freight route by continuing service from the vicinity of Pocomoke City through Accomack and Northampton Counties for approximately

sixty miles to the southern tip of the Peninsula. The Maryland and Delaware Railroad provides east - west freight service five times per week between Seaford, in west-central Sussex County, and Cambridge, in northwestern Dorchester County, and three times weekly between the community of Clayton, located in north-central Kent County (Delaware), and the central Talbot County city of Easton.

In mid-1978 both railroad companies were participating in the Federal Light Density Line program. Under the provisions of the program, Federal assistance of 80 percent, supplemented by either 20 percent State or private funds, was made available to rehabilitate relatively unsafe and inefficient rail beds. The purpose of the program was to insure that deteriorated rail stock was upgraded to comply with the Federal ten mile per hour minimum speed and safety standard.

National and international air passenger and freight service is available in major metropolitan areas adjacent to the Peninsula at airports in Norfolk, Baltimore, and Wilmington. On the Peninsula, airports at Dover and Salisbury provide area residents and businesses with regional and commuter air service within the Northeastern corridor while numerous small airstrips provide charter service and private aviation facilities. The major bus companies such as Trailways and Greyhound serve the region with terminals located in the larger population centers.

The Peninsula is surrounded by several major waterways: the Delaware River, the Chesapeake and Delaware Canal, Chesapeake Bay and Atlantic Ocean. The C&D Canal is a transportation link between Philadelphia and Baltimore. The canal is used by large ocean going vessels because it shortens the route

from Baltimore to Philadelphia by 316 miles, to New York by 179 miles, and to European ports by about 100 miles.[1/]

Commerce through the C&D Canal is dominated by domestic movements of bulk oil and foreign movements of general cargo which together accounted for approximately 70 percent of total traffic in 1972. In addition to bulk oil and general cargo, there are significantly smaller quantities of coal, ore, grain, and miscellaneous bulk commodities passing through the C&D Canal. During the 1965-1972 period an average of about 1.1 million short tons of cargo was transported through the canal annually. The potential exists for a substantial increase in tonnage if a significant number of Northeastern power plants convert from oil to coal. In 1977, the depth of the C&D Canal was increased from 27 to 35 feet.

Although the port of Baltimore is not located on the Peninsula, it performs a major import-export function for the region. In 1972, approximately 58 percent of the vessels engaged in foreign traffic destined for or leaving the port of Baltimore traveled through the C&D Canal. Located fifty to two hundred miles further inland than other Atlantic ports, Baltimore serves the Midwest markets more economically. In terms of trade, the port of Baltimore exports large quantities of coal and grain while importing considerable amounts of iron ore and petroleum. The port of Baltimore is second to New York City in container cargo handled and is ranked fourth in the United States in volume of foreign trade handled.

The only deep water port that is located on the Peninsula is Cambridge, Maryland. The municipal channel to Cambridge is twenty-five feet deep. Cambridge is considered a general cargo deep water port capable of handling moderate sized vessels. Several other inland communities on the Peninsula

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1/ Chesapeake Bay, Existing Conditions Report - Appendix A, Department of the Army, Baltimore District, Corps of Engineers, p. A-II-8 (1973).

have port facilities served by shallower channels. In 1972, the Wicomico River, with a 14 foot deep channel leading to Salisbury, and the Nanticoke River, dredged 12 feet deep to Seaford, handled inland barge movements of approximately .7 million and .5 million short tons of bulk oil, respectively. Both the Tred Avon River, with a 12 foot deep channel to Easton, and the Choptank River, dredged to a depth of 8 feet to Denton, received moderate amounts of inbound barge traffic bearing oil, fertilizer, and slag for construction purposes.1/

Water and Related Land Resources

Population growth and economic development are significant factors on both the supply and demand sides of the use of water and related land resources, as the availability and abundance of these resources may stimulate growth. For example, the Delmarva Peninsula's proximity to the Chesapeake Bay and the Atlantic Ocean makes the area ideal for recreation. Growth in this industry may be stimulated by the fact that open land is available upon which second (vacation) homes or recreation sites may be built.

Additional development on the Peninsula would mean an increase in employment, incomes, and in the well being of area residents. However, subsequent growth would place many demands upon the natural resource base. Population growth, increasing incomes, and expansion of industrial output demand electric power, transportation services, and recreational opportunities. These products and services are dependent upon water, land use, and development.

The interrelationship between the use of water and land is complex. Development of land for agricultural, commercial, or residential use may require engineering measures to lower the water table for drainage or flood protection purposes and concurrent water resource development to provide adequate

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1/ Chesapeake Bay Future Conditions Report, (Volume 1, Summary, August of 1977), pages 67-74.

water supplies for municipal purposes or for irrigation. Additionally, the quantity and quality of water is influenced by the use of land in that urban and industrial growth are frequently the causes of flooding, water pollution, and sedimentation.1/ The increasing demand for land, which affects water use in turn, is expressed succinctly by Marion Clawson: "....as total population grows, more land will be required for site purpose... for primary homes, for second homes, for shopping centers, for offices, etc. As incomes rise and as leisure increases, more land will be used for recreation either as the sole use or as one of several uses. More people will require more food... and higher outputs per acre may meet most or all of the increased volume of food commodities required by more people."2/

The use of water and related land resources is linked with population, income, and employment growth. Increasing numbers of persons with higher incomes and more jobs will cause more intensive use of water and related land. Consequently, growth will affect the future availability and cost of these finite resources. Effective resource management and planning for the area should provide for regional growth and prosperity while maintaining and protecting the unique environment that exists on the Delmarva Peninsula.

1/ Don Maughan, Water Resources Planning (New York, 1971), p. 88.
2/ Marion Clawson, National Land Use Policy (New York, 1971), p. 31.

POPULATION CHARACTERISTICS

This section presents general parameters of population and income supplemented by indicators of the age distribution of the population, educational levels achieved, the composition of the labor force, unemployment, population density, income distribution and poverty, and housing conditions.

As shown in Table 1, the number of persons residing on the Peninsula in 1970 - the date of the most recent official census survey - was 849,868. This total represented an increase of 270,028 (or 46.6%) over the 1950 population. The national population grew approximately thirty-three percent over the same twenty year period, considerably less than the Peninsula growth.

According to the Bureau of Census population estimates and projections, the number of persons residing within the confines of the Delmarva Peninsula in 1976 was 907,200. During the six year period between 1970 and 1976 the population was estimated to have increased by 57,332 or 6.7 percent. Over the twenty-six year period between 1950 and 1976 the Peninsula experienced an increase of 327,360 (or 56.5%) in population.

Table 1 also presents data on the rural population of the Peninsula and its farm and non-farm components. The growth of the Peninsula population and of the rural and rural non-farm population is also illustrated in Figure B. In 1970, 47.1 percent of the Peninsula population was classified as "rural" and 3.7 percent was "rural farm." In 1950, these statistics were 57.3 percent and 17.0 percent respectively.

The Peninsula totals shown, however, are not truly representative of the Peninsula proper (the area below the C&D Canal) due to the inclusion of data for Cecil County, Maryland, and New Castle County, Delaware. In

Table 1 - Total population (1950, 1960, and 1970, plus 1976 projections) and rural population (1950, 1960, and 1970), Delmarva Peninsula.

Subarea	Total population 1950	1960	1970	1976 [1]	Rural population 1950	1960	1970	Percent rural 1950	1960	1970
Delmarva Peninsula	579,840	737,463	849,868	907,200	332,299	393,337	400,319	57.3	53.3	47.1
Delaware	318,085	446,292	548,093	582,100	118,863	153,504	152,943	37.4	34.4	27.9
Kent	37,870	65,651	81,892	91,900	29,393	52,912	50,269	77.6	80.6	61.4
New Castle	218,879	307,446	385,851	401,200	39,850	41,108	33,771	18.2	13.4	8.8
Sussex	61,336	73,195	80,350	89,000	49,620	59,484	68,903	80.9	81.3	85.8
Maryland	210,623	243,570	258,329	278,800	165,028	192,232	203,930	78.3	78.9	78.9
Upper Shore	99,274	121,498	131,322	141,400	86,050	105,570	110,418	86.7	86.9	84.1
Caroline	18,234	19,462	19,781	22,100	18,234	19,462	19,781	100.0	100.0	100.0
Cecil	33,356	48,408	53,291	55,100	28,111	42,419	42,672	84.3	87.6	80.1
Kent	13,677	15,481	16,146	16,900	10,534	11,879	12,670	77.0	76.7	78.5
Queen Annes	14,579	16,569	18,422	21,600	14,579	16,569	18,422	100.0	100.0	100.0
Talbot	19,428	21,578	23,682	25,700	14,592	15,241	16,873	75.1	70.6	71.2
Lower Shore	111,349	122,072	127,007	137,400	78,978	86,662	93,512	70.9	71.0	73.6
Dorchester	27,815	29,666	29,405	30,100	17,464	17,427	17,810	62.8	58.7	60.6
Somerset	20,745	19,623	18,924	20,000	17,057	16,083	15,849	82.2	82.0	83.8
Wicomico	39,641	49,050	54,236	60,500	24,500	32,748	38,984	61.8	66.8	71.9
Worcester	23,148	23,733	24,442	26,800	19,957	20,404	20,869	86.2	86.0	85.4
Virginia	51,132	47,601	43,446	46,300	48,408	47,601	43,446	94.7	100.0	100.0
Accomack	33,832	30,635	29,004	30,900	31,108	30,635	29,004	91.9	100.0	100.0
Northampton	17,300	16,966	14,442	15,400	17,300	16,966	14,442	100.0	100.0	100.0

1 1976 figures derived from current Population Reports (Series P-26) September, 1977. Issued by United States Department of Commerce, Bureau of the Census

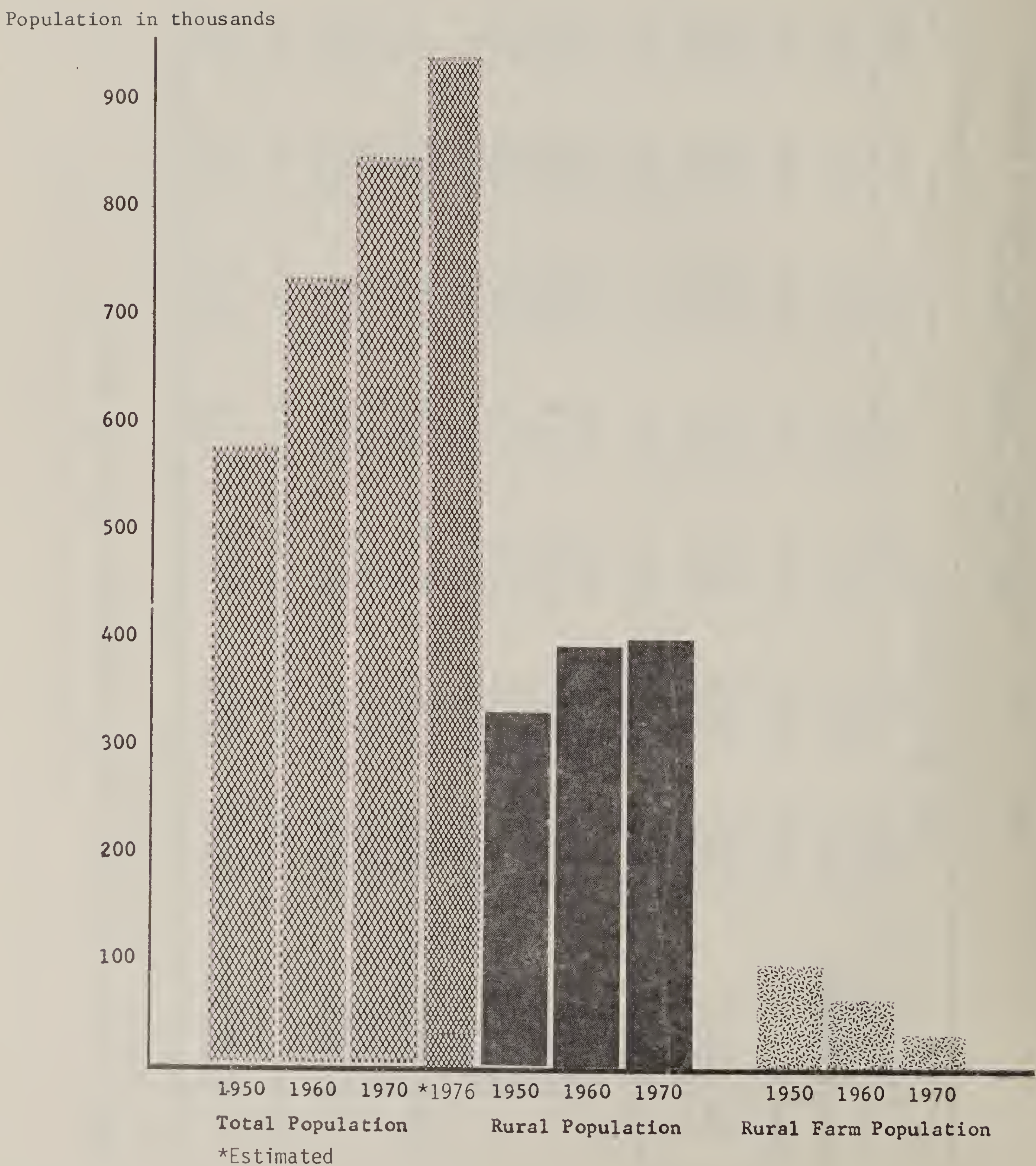
Table 1 - Total population and rural population, Delmarva Peninsula, 1950, 1960, and 1970. (cont'd.)

Subarea	Rural nonfarm population			Rural farm population			Percent rural farm [1]		
	1950	1960	1970	1950	1960	1970	1950	1960	1970
Delmarva Peninsula	233,983	332,298	368,908	98,316	61,039	31,411	17.0	8.3	3.7
Delaware	84,638	131,683	141,583	34,225	21,821	11,360	10.8	4.9	2.1
Kent	18,989	46,165	46,517	10,404	6,294	3,752	27.5	9.6	4.6
New Castle	33,447	37,386	31,731	6,403	3,722	2,040	2.9	1.2	0.5
Sussex	32,202	47,679	63,335	17,418	11,805	5,568	28.4	16.1	6.9
Maryland	115,049	160,473	185,983	49,979	31,759	17,947	23.7	13.0	6.9
Upper Shore	60,170	88,198	100,248	25,880	17,372	10,170	26.1	14.3	7.7
Caroline	11,546	15,078	17,406	6,688	4,384	2,375	36.7	22.5	12.0
Cecil	21,655	38,882	40,180	6,456	3,537	2,492	19.4	7.3	4.7
Kent	7,501	9,095	11,031	3,033	2,784	1,639	22.2	18.0	10.2
Queen Annes	9,406	12,832	16,765	5,173	3,737	1,657	35.5	22.6	9.0
Talbot	10,062	12,311	14,866	4,530	2,930	2,007	23.3	13.6	8.5
Lower Shore	54,879	72,275	85,735	24,099	14,387	7,777	21.6	11.8	6.1
Dorchester	11,920	14,277	16,225	5,544	3,150	1,585	19.9	10.6	5.4
Somerset	12,922	13,454	14,341	4,135	2,629	1,508	19.9	13.4	8.0
Wicomico	17,052	28,307	36,523	7,448	4,441	2,461	18.8	9.1	4.5
Worcester	12,985	16,237	18,646	6,972	4,167	2,223	30.1	17.6	9.1
Virginia	34,296	40,142	41,342	14,112	7,459	2,104	27.6	15.7	4.8
Accomack	22,485	26,035	27,995	8,623	4,600	1,009	25.5	15.0	3.5
Northampton	11,811	14,107	13,347	5,489	2,859	1,095	31.7	16.9	7.6

1 As a percent of total population.

Source: Bureau of the Census, Census of Population 1950, 1960, and 1970.

Figure B
Delmarva Population Trends: 1950-1970 and 1976



both counties, the majority of the population resides north of the canal and, thus, outside the survey area. If these two counties are not included in the Peninsula totals, the population growth and the rural population statistics are markedly different:

Area	Population growth 1950-1970	Percent rural 1950	Percent rural 1970	Population growth 1970-1976	Population growth 1950-1976
Delmarva Peninsula (14 Counties)	46.6%	57.3	47.1	6.7%	56.5%
Delmarva Peninsula (excluding Cecil and New Castle Counties)	25.4%	80.7	78.9	1.5%	31.6%

Accordingly, one can conclude that the population of the survey area grew at a considerably slower rate than the national population over the same period and that it remained overwhelmingly rural. These conclusions are confirmed by an examination of the county data in Table 1. Between 1950 and 1970, three counties (Accomack and Northampton, Virginia, and Somerset, Maryland) actually lost population and an additional three counties gained less than 10 percent. Of the counties wholly in the survey area, only Kent County, Delaware, grew faster than the national rate.

The 1976 net migration statistics - which take into account births, deaths, and migration - reflected a continuation of the slow population growth rate trend of the previous two decades. However, some interesting differences occurred in regard to the size and rate of population change among the counties of the Peninsula. Sussex County, Delaware, with a 6,100 (7.6%) increase, experienced the largest net population gain. Closely following were Wicomico County, Maryland, with a 5,000 (9.1%) net increase and Kent County, Delaware, with a net gain of 4,000 (4.8%). The largest proportional

gain, 17 percent, occurred in Queen Anne's County, Maryland, where a 3,100 increase occurred in the third least populated county on the Peninsula. Only Cecil County, Maryland, and New Castle County, Delaware, experienced small net population decreases.

During the 26 year period between 1950 and 1976, the northern section of the Peninsula experienced relatively moderate rates of population increase. The population growth rates of the three counties comprising Delaware plus Cecil County, Maryland, ranged from 45.1 to 142.7 percent. However, in the southern section of the Peninsula - except for Wicomico County, Maryland - the average change in population was negligible. Wicomico County accounted for 20,859 (or 98%) of the 21,219 net population increase in the six county area.[1/]

In four counties, the 1970 population was entirely rural and four others were over 80 percent rural. It is interesting to note, however, that all of the counties experienced a major shift in the rural population from the farm to the non-farm classification. In only two counties in 1970 was more than 10 percent of the population classified rural-farm whereas all but one county in 1950 had more than 10 percent in this category.

The age distribution of the Peninsula population (Table 2) in 1970 differed only slightly from that of the national population. There were proportionally more persons in the 0-19, 30-39, and 40-49 years age groups and proportionally less in the remaining age groups than in the Nation as a whole. Notably, there were proportionally fewer young adults (20-29 years age group), both male and female, in the Peninsula population than in the national population. This

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1/ 1976 net migration figures derived from Current Population Reports (Series P-26) September 1977. Issued by United States Department of Commerce, Bureau of the Census.

Table 2--Age distribution of the Delmarva Population, with National comparison, 1970

Sex and age group(years)	Number	Percent Distribution	National Comparison 1/
Male:			
0-19	166,513	40.2	101.5
20-29	57,804	13.9	94.6
30-39	47,187	11.4	102.7
40-49	50,250	12.1	102.5
50-59	43,060	10.4	102.0
60 and over	49,782	12.0	95.2
All males	414,596	100.0	
Female:			
0-19	161,727	37.1	102.5
20-29	62,209	14.3	97.3
30-39	48,919	11.2	100.9
40-49	52,887	12.2	102.5
50-59	44,719	10.3	98.1
60 and over	64,822	14.9	95.5
All females	435,283	100.0	
Both Sexes:			
0-19	328,240	38.7	102.4
20-29	120,013	14.1	95.9
30-39	96,106	11.3	101.8
40-49	103,137	12.1	101.7
50-59	87,779	10.3	99.0
60 and over	114,604	13.5	95.7
Total	849,879	100.0	

1/ Identical regional and national distributions imply index numbers of 100.0

Source: Bureau of the Census, 1970 Census of Population

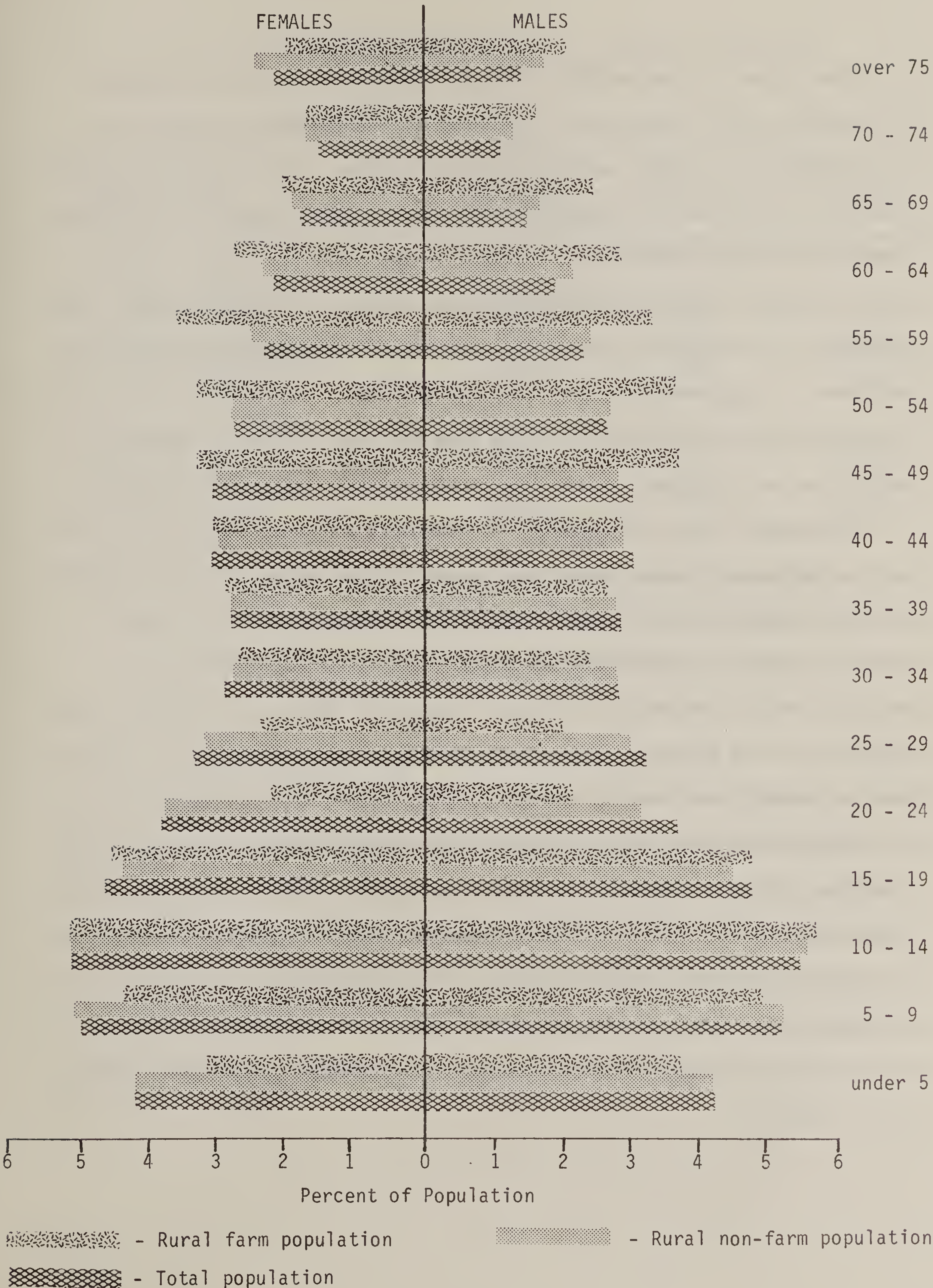
indicates that young adults were leaving the Peninsula in search of superior employment opportunities.

The composition of age and sex within the Peninsula population has important implications for individual resource demands and economic potential. From changes in the age distribution flow important consequences for the educational, economic, social, and political life of a community. A useful device for observing these changes is the population pyramid. Figure C illustrates the percentage of males and females in 5-year age groups for the total population, the rural non-farm population, and the rural farm population. Examination of Figure C indicates that in 1970 there were fewer children under the age of 5 than in the 5-9, 10-14, and 15-19 age groups. The decline in total births was due to the combination of a declining birth rate and a reduced number of young adults. This was most evident in the rural farm population where young adults were a significantly smaller proportion of the population than their counterparts in the total population and in the rural non-farm population. This was a further indication of the migration of young adults from the farm population into the non-farm sector on the Peninsula and of young adults in general. In the age groups from 40-44 and above, there were proportionally more persons in the rural farm population in these age groups than in the rural non-farm and the total populations. This was most pronounced in the 50-54 and 55-59 year age groups.

Several short-term and long-term implications may be drawn from the age and sex structure of the Delmarva population. In the short run, the reduced number of children under five required less educational facilities as they reached school age. In many instances, facilities became underutilized -

Figure C

Delmarva Age-Sex Pyramid - 1970



with older schools being vacated, sold, or used for other public purposes. The declining school population resulted in the curtailment of curriculum and a reduction in overall educational opportunities. This had the greatest impact on rural areas where opportunities were already limited. At the same time, an increased proportion of citizens in the older age groups required public services, housing, and transportation responsive to their needs. The migration of young adults reduced the labor force for existing and potential employers -- aggravating existing economic problems. The 1970 age distribution focused attention on the need for long-term programs to provide economic opportunities for young adults equal to those available outside the Peninsula.

Educational levels attained by the Peninsula population 25 years old and over in 1970 were somewhat lower than those attained by the national population. As Table 3 indicates, there was a considerably larger proportion of the Peninsula population, both male and female, with less than eight years of education than in the Nation at large. Similarly, there was a slightly larger proportion of the Delmarva population with only an elementary school education. These relatively low levels of educational achievement were reflected in the low percentage of high school graduates, particularly males. The percentage of college graduates among the Peninsula population, however, was very close to the national statistic. It should be noted that the statistics presented were for the population age 25 and over. The educational achievement of the population under that age will be greater because of compulsory attendance laws and increased opportunities that were not available to the older members of the population.

Table 3--Educational achievement of the Delmarva population, with National comparison, 1970

Highest Grade Level Completed	Peninsula Population	National Population	National Comparison 1/
	---Percent---		
Males Age 25 and Over:	100.0	100.0	--
Less than 8 years	21.2	16.6	127.7
Elementary school graduate	32.8	31.5	104.1
High School graduate	32.4	38.4	84.4
College graduate	13.6	13.5	100.7
Female Age 25 and Over:	100.0	100.0	--
Less than 8 years	16.3	13.6	119.9
Elementary school graduate	35.4	32.7	108.3
High School graduate	40.4	45.6	88.6
College graduate	7.9	8.1	97.5

1/ Identical regional and national distributions imply index numbers of 100.0

Source: Bureau of the Census, 1970 Census of Population

These educational statistics are important because unemployment problems result if the employment needs of local industry are not compatible with the job skills of the labor force. An important aspect of economic planning is to complement new industry with available job skills. Unless employment opportunities are provided locally for skilled workers, the tendency for young adults to seek employment outside the Peninsula will be exacerbated. Similarly, employment for the unskilled is a necessary ingredient for a viable local economy.

Labor Force

Labor force data (1970) for the Peninsula's male and female populations are presented in Table 4. The civilian unemployment rates in 1970 of 2.4 percent for males and 2.5 percent for females compared favorably with the national unemployment rate of 4.9 percent for both sexes combined. Females have increased their participation in the labor force from 36.9 percent in 1960 (age 14 and over) to 43.5 percent in 1970 (age 16 and over). It is unlikely that the change in age groups accounted for more than a minor fraction of the increase. Approximately 10,000 women on the Peninsula were employed in the food processing and recreation industries while an additional 3,500 women were employed in the manufacture of men's shirts and children's clothing. Women were more concentrated in these industries because much of the work was part-time, seasonal, or required skills that the male labor force had not acquired through experience or training.

An insight into labor participation and potential may be gained by examining a portion of a community economic inventory for Wicomico County, Maryland.[1/]

Total employment in Wicomico County (1970) was approximately 22,647. The Department of Employment Security estimated average annual unemployment in Wicomico County at about 3.2 percent in calendar year 1969 - a figure fairly representative for the Peninsula as a whole. The Inventory also noted that there was a substantial potential labor force within Wicomico County. Approximately 5,213 persons in seven major components were included in the supply of labor available within Wicomico County. These were:

1/ Community Economic Inventory-Wicomico County, Maryland Division of Development, Annapolis, Maryland, 1971.

Table 4--Labor force by status and sex, Delmarva Peninsula, 1960 and 1970

Status and Sex	AGE 14 AND OVER(1960) AND AGE 16 AND OVER(1970) 1960 Number	1960 Percent	1970 Number	1970 Percent	Percent Change 1960-1970
Male:					
In the labor force--	98,512	78.3	218,802	78.5	11.0
Military	10,848	4.3	10,122	3.6	-6.7
Civilian:	187,664	74.0	208,680	74.9	11.2
Employed	177,572	70.0	201,958	72.5	13.7
Unemployed	10,092	4.0	6,722	2.4	-33.4
Not in the labor force--	55,060	21.7	59,911	21.5	8.8
Inmate of institution	4,721	1.8	4,191	1.5	-11.2
Enrolled in school	19,521	7.7	18,258	6.6	-6.5
Other:					
Under age 65	12,385	4.9	14,582	5.2	17.7
65 and over	18,433	7.3	22,880	8.2	24.1
All males	253,572	100.0	278,713	100.0	9.9
Female:					
In the labor force--	97,266	36.9	132,603	43.5	36.3
Military	648	0.3	626	0.2	-3.4
Civilian:	96,618	36.6	131,977	43.3	36.6
Employed	90,190	34.2	124,376	40.8	37.9
Unemployed	6,428	2.4	7,601	2.5	18.2
Not in the labor force--	166,564	63.1	172,460	56.5	3.5
Inmate of institution	2,893	1.1	3,750	1.2	29.6
Enrolled in school	20,173	7.6	20,013	6.6	-0.8
Other:					
Under age 65	113,208	42.9	110,464	36.2	-2.4
65 and over	30,290	11.5	38,233	12.5	26.2
All females	263,830	100.0	305,063	100.0	15.6

Source: Bureau of the Census, 1970 Census of Population

Component	Number
1. Active unemployment insurance claimants	450
2. Unemployed, claims expired	160
3. Unemployed, not claimants for unemployment insurance	988
4. Underemployed who would shift from low paying or seasonal jobs	3,000
5. High school graduates expected to enter the labor force annually	265
6. Residents commuting to work outside the County but available in the County if comparable jobs offered	125
7. Women not now in labor force but available if jobs offered	225
Estimated total potential	5,213

In 1970, more than seventy-eight percent of the employed population worked where they resided (Table 5). This high degree of local employment was probably related to the low population density (65 persons per/square mile) and to the rural aspect of the area.

Table 5--Place of work, Delmarva Peninsula, 1970

Place of work	Number	Percent
All workers	328,683	100.0
Worked in county of residence	258,154	78.6
Worked outside of county of residence	45,092	13.7
Place of work not reported	25,437	7.7

Source: Bureau of the Census, 1970 Census of Population

Income

Total personal income within the Peninsula increased approximately 1.2 billion dollars from 1950 to 1971 (Table 6).1/ This growth enabled the

1/ Total personal income is the current income received by residents of an area from all sources. It is measured before deduction of income and other personal taxes but after deduction of personal contributions to social security, government retirement and other social insurance programs.

Table 6--Personal income, per capita income, and employment, Delmarva Peninsula, selected years 1950-71 1/

Item	1950	1960	1970	1971
	1967 dollars			
Total personal income (1,000 dollars)	$423,700	$665,300	$1,570,500	$1,667,700
Percent of national total	0.18	0.17	0.19	0.19
Population, July 1	329,400	377,500	412,100	418,000
Per capita income	1,286	1,762	3,811	3,990
Percent of national per capita income	86.0	82.0	97.0	96.0
Total employment	130,396	144,266	185,542	2/
Percent of population employed	39.6	38.2	45.0	2/

1/ Not including Cecil County, Maryland, and New Castle County, Delaware.
2/ Not available

Source: U.S. Department of Commerce, Bureau of Economic Analysis

Peninsula to increase its share of the national income from .18 percent to .19 percent. The modest increase indicated that a pattern of slow, steady growth was taking place in the area.

Per capita income was derived by dividing total income by the midyear population of the area. On the Delmarva Peninsula per capita income increased from $1,286 in 1950 to $3,990 in 1971 (Table 6). Per capita income is the average return for participation in the economic activity of an area. Thus, changes in per capita income reflect the balance between rates of growth in population and income. The per capita income of the Peninsula has been historically less than that of the Nation; however, personal income increased from 86 percent of that for the Nation in 1950 to 96 percent in 1971.

In 1970, average family income on the Delmarva Peninsula (Table 7) was more than the national average. However, there were a greater percentage of families living on the Peninsula with incomes less than the poverty level than was representative of the Nation. Although the mean income level of the poverty families was slightly more than the respective national figure, the average income for unrelated individuals fell below the comparable national figure.

The mean income level of the poverty families and unrelated individuals was proportionally below the respective mean incomes for all families or persons. The poverty level families had mean incomes of 18.8 percent of the all family mean. Poor unrelated individuals fared only slightly better at 22.5 percent of the unrelated individual mean. The comparisons are even more discouraging when it is noted that inmates of institutions, members of the armed forces in barracks, college students in dormitories, and unrelated

Table 7--Income and poverty status of families and unrelated individuals, Delmarva Peninsula and United States, 1970

(Current dollars)

	Delmarva Peninsula		United States	
	Number	Mean Income	Number	Mean Income
All families:	213,990	$10,775	51,168,599	$9,590
Families with incomes less than the poverty level	23,541	$2,028	5,462,216	$1,935
Percent of all families	11.0	18.8	10.7	20.2
All unrelated individuals:	74,718	$3,637	16,052,389	$3,889
Individuals with incomes less than the poverty level	24,504	$817	5,944,956	$861
Percent of all individuals	32.8	22.5	37.0	22.1

Source: Bureau of the Census, 1970 Census of Population

individuals fourteen years of age and under are excluded from these definitions. There were a substantial number of persons with low incomes and this consuming group required a different mix of housing, recreation, transportation and job opportunities than persons with higher incomes.

Housing Conditions

A 1970 comparison between the general housing conditions on the Delmarva Peninsula and in the United States (Table 8) revealed a greater percentage of seasonal housing and other vacant units on the Peninsula. This was not unusual insofar as a large part of the Peninsula is utilized for recreation and seasonal or second homes are numerous. Of the year round units that existed on the Peninsula in 1970, more than 10 percent lacked some or all plumbing facilities while the national percentage was approximately 7 percent.

Table 8—General housing conditions, Delmarva Peninsula, 1970

Item	Delmarva Peninsula Number	Delmarva Peninsula Percent	U. S. Percent
Total population:	849,868	100.0	100.0
Population in units	823,330	96.9	97.1
Population in group quarters	26,538	3.1	2.9
All housing units:	293,589	100.0	100.0
Vacant-seasonal or migratory 1/	13,071	4.5	1.5
All year units--	280,518	95.5	98.5
Owner-occupied	175,999	59.9	58.1
Renter-occupied	83,459	28.4	34.3
Vacant for sale or rent	8,537	2.9	3.1
Other vacant 2/	12,523	4.3	3.0
All-year units:	280,518	100.0	100.0
With all plumbing facilities	250,426	89.3	93.1
Lacking some or all plumbing	30,092	10.7	6.9
Occupied units:	259,458		
Units with 1.01 or more persons per room	16,481	6.4	8.2

1/ Beach houses, hunting cabins, etc. and units used solely to house migratory labor.
2/ Houses vacant for any reason other than sale or rent, condemned units, or other units unfit for habitation, are not included as any type of housing unit.

Source: Bureau of the Census, 1970 Census of Population.

THE GENERAL ECONOMY

Data for the period 1950 through 1970 suggest that the Delmarva Peninsula continued to experience a transition from an essentially agrarian economy to a modern mixed economy based on manufacturing and services in addition to agriculture. It should be noted, however, that this phase of economic growth did not begin on the Peninsula until relatively late in its economic development. Early industrial growth in the Middle Atlantic region occurred in proximity to sources of power and raw materials. The Peninsula, like the Coastal Plain in general, lacked the topography necessary for water power and had no deposits of coal or important minerals. It did, however, have the soils and temperate climate that encouraged intensive agricultural development. Similarly, abundant forest resources supported the development of a large forestry sector and the surrounding waters yielded large harvests of shellfish, crabs, and finfish. The location of the Peninsula with respect to major urban markets was also propitious. With the advent of railroads and, later, highway systems, transportation of the Peninsula's products shifted from ships and barges to the land modes. Because of its geography, however, the Peninsula was still relatively isolated and this discouraged the development of a diversified manufacturing sector. Typical of most agricultural areas, the Peninsula during the period had a labor surplus. Some of this surplus was absorbed by labor-intensive manufacturing enterprises such as clothing and apparel, but the remainder left the Peninsula in search of superior employment opportunities.

Completion of the Chesapeake Bay Bridge in 1952 marked a significant turning point in the Peninsula's economic development. The Bridge represented a major improvement in the Peninsula's accessibility with respect to the Baltimore - Washington, D.C., metropolitan area and states to the west and

south. The economic impact was two-fold. First, industrial development was stimulated by removal of the impediment to east-west travel posed by the Bay (despite ferry service). Second, the Bridge provided ready access to the Eastern Shore and the Atlantic beaches for residents of the Baltimore-Washington area. The Peninsula had historically been a popular area for summer recreation, but the increased demand for recreation created by rising incomes and increased leisure time was a powerful stimulus for further recreational development of the resources of the Peninsula once the Bridge became available for use. The opening of the Bridge-Tunnel at the mouth of the Bay in 1965 further improved accessibility -- particularly into the southern half of the Peninsula.

Along with the transportation improvements made in the 1950's and 1960's, other forces and events acted to transform the Delmarva economy. The national economy - which experienced considerable growth and change following World War II - profoundly influenced the rate of growth and pattern of change in the economy of the Delmarva region. A national trend that had a particularly important local impact was the increasing consumption of services relative to goods. In the immediate post-war years, federal, state, and local government expenditures and employment expanded significantly reflecting an increased demand for public services. The Dover, Delaware, area benefited directly from the growth of state government activity as well as from the reactivation of Dover Air Force Base in 1951 and its continued operation as a major Military Airlift Command facility. All parts of the Peninsula, however, shared the overall stimulus provided by increased governmental expenditures. Increased demand for recreation services also had a considerable impact on the Peninsula. To some extent, this impact was focused on development of the

Atlantic Coast resorts of Ocean City, Maryland, and Rehoboth Beach, Delaware. However, the entire Peninsula provided quality recreation and recreational development was widespread.

One result of the changed structure of the regional economy was that it significantly affected the distribution of population among the towns and cities of the Peninsula. By 1970 two major growth centers had emerged. In the northern half of the Peninsula, Dover, Delaware became the principal center for wholesale and retail trade and the supply of specialized urban services. In part this was due to a locational advantage, but the expansion of state government in the capital city and increased activity at the Air Base caused very rapid population growth. As Table 9 indicates, the 1970 population of 17,488 was about one and one-half times larger than the population only ten years earlier. In 1960, Dover ranked third among the cities and towns on the Peninsula in terms of population.

Table 9--Population and population rank of Delmarva cities and towns, 1960 and 1970[1/]

City,	County,	State	Population 1960	Population 1970	Percent Change 1960-70	Rank 1960	Rank 1970
Dover	Kent	Delaware	7,250	17,488	141.2	3	1
Salisbury	Wicomico	Maryland	16,302	15,252	-6.4	1	2
Cambridge	Dorchester	Maryland	12,239	11,595	-5.3	2	3
Easton	Talbot	Maryland	6,337	6,809	7.4	4	4
Seaford	Sussex	Delaware	4,430	5,537	25.0	6	5
Milford	Sussex	Delaware	5,795	5,314	-8.3	5	6

1/ 1970 populations of 5,000 persons or more

Source: U.S. Dept. of Commerce, 1970 Census of Population

In the southern half of the Peninsula, Salisbury, Maryland serves as a major regional trade center. Strategically located at the junction of U.S. Routes 13 and 50, Salisbury benefited from the ever-increasing flow of traffic to Ocean City and shore points. The population of Salisbury proper decreased slightly from 1960 to 1970 and the city slipped to second in the ranking of Peninsula cities by population. However, due to the development of unincorporated tracts of land beyond the city, the population of the entire metropolitan Salisbury area increased somewhat over the 1960 level. Of the remaining Delmarva cities and towns with populations in excess of 5,000, only Seaford, Delaware, and Easton, Maryland had positive population growth rates between 1960 and 1970 (Table 9).

Employment

Some insight into the changes that occurred in the economy of the Peninsula between 1950 and 1970 is provided by an examination of employment trends among and within industry sectors over time. Though this approach ignores structural interdependencies among sectors and obscures the effects of interregional economic developments on the local economy, it does provide a revealing overview of the magnitude and composition of changes in the industrial structure of the region.

Peninsula employment by industry sector for 1950 and 1970 is shown in Table 10. Also shown in Table 10 are the absolute and percentage changes in employment by industry between 1950 and 1970 and the present distribution of total employment over industry sectors in each year. Total employment in the twelve counties below the canal increased by 33,562 (or 25.7 percent) over the 1950-70 period.[1/] This was essentially the same as the relative increase in

1/ Statistics presented in this section exclude data for Cecil County, Maryland, and New Castle County, Delaware.

Table 10 - Employment by industry sector, 1950 and 1970, and change in industry employment, 1950-1970, Delmarva Peninsula.

Industry	1950		1970		Change 1950--1970	
	Number	Percent of total	Number	Percent of total	Number	Percent
Agriculture, forestry, and fisheries	35,363	27.1	15,159	9.2	-20,204	-57.1
Mining	63	*	140	0.1	77	122.2
Contract construction	9,375	7.2	13,393	8.2	4,018	42.9
Manufacturing	28,838	22.2	40,515	24.7	11,677	40.5
Food and kindred products mfg.	10,109	7.8	15,038	9.2	4,929	48.8
Textile and apparel products mfg.	5,100	3.9	7,042	4.3	1,942	38.1
Lumber, wood products, furniture mfg.	5,035	3.9	1,470	0.9	-3,565	-70.8
Printing and publishing	605	0.5	2,345	1.4	1,740	287.6
Chemicals and allied products mfg.	2,794	2.1	4,040	2.5	1,246	44.6
Electrical and other machinery mfg.	520	0.4	2,881	1.8	2,361	454.0
Motor vehicles and equipment mfg.	496	0.4	1,213	0.7	717	144.6
Other and miscellaneous mfg.	4,179	3.2	6,486	3.9	2,307	55.2
Transportation, communications, and utilities	7,048	5.4	8,584	5.2	1,536	21.8
Railroads and railway express	1,182	0.9	361	0.2	-821	-69.5
Trucking and warehousing	2,097	1.6	2,481	1.5	384	18.3
Other transportation	1,482	1.1	1,658	1.0	176	11.9
Communications	1,037	0.8	1,712	1.0	675	65.1
Utilities and sanitary service	1,250	1.0	2,372	1.5	1,122	89.8
Wholesale and retail trade	20,855	16.0	31,143	19.0	10,288	49.3
Wholesale trade	4,500	3.4	6,229	3.8	1,729	38.4
Food and dairy products stores	3,891	3.0	4,122	2.5	231	5.9
Eating and drinking places	2,428	1.9	3,610	2.2	1,182	48.9
Other retail trade	10,036	7.7	17,182	10.5	7,146	71.2

Table 10 - Employment by industry sector, 1950 and 1970, and change in industry employment, 1950-1970, Delmarva Peninsula.

Industry	1950		1970		Change 1950—1970	
	Number	Percent of total	Number	Percent of total	Number	Percent
Finance, insurance and real estate	2,266	1.7	4,526	2.8	2,260	99.7
Services	18,868	14.5	35,601	21.7	16,733	88.7
Hotels and other personal services	3,329	2.6	5,072	3.1	1,743	52.4
Private households	5,156	4.0	3,843	2.3	-1,313	-25.5
Business and repair services	2,926	2.2	2,939	1.8	13	0.4
Entertainment, recreation services	679	0.5	1,192	0.7	513	75.6
Medical, other professional services	6,778	5.2	22,555	13.8	15,777	232.8
Public administration	3,622	2.8	8,416	5.1	4,794	132.4
Armed Forces	1,735	1.3	6,481	4.0	4,746	273.5
Industry not reported	2,363	1.8	0	0.0	0	0.0
Delmarva Peninsula Total	130,396	100.0	163,958	100.0	33,562	25.7

Source: Growth Patterns in Employment by County, 1940-1950 and 1950-1960, Vol. 2., U.S. Department of Commerce/ Office of Business Economics (Washington, D.C., 1965).
Bureau of the Census, 1970 Census of Population.

population of 25.4 percent. The increase in total employment implies that there was an average annual growth rate of only 1.2 percent. Within industrial sectors, changes in employment over the period varied much more widely than total employment. A closer examination of the data in Table 10 reveals industry growth rates ranged from -70.8 percent to 454.0 percent. Trends in major sectors are outlined below.

Agriculture. Direct employment in agriculture, forestry, and fisheries experienced the largest absolute decline of all major sectors in the Delmarva economy. Total employment fell from 35,363 in 1950 to 15,159 in 1970, a 57.1 percent decrease. In 1950, one Peninsula job in four was in the agricultural sector. In 1970, however, less than one job in ten was directly related to agriculture (including forest and fish cultivation). In part, the decline reflected national trends of increased mechanization and increased farm size, but regional shifts in cropping patterns away from the production of labor intensive truck crops also occurred. As the regional economy grew, rising wage rates for unskilled and semi-skilled labor resulted in less direct agricultural employment as farm operators shifted to the production of field crops or left agriculture in favor of non-farm employment.

Mining. Employment in mining more than doubled over the twenty-year period, but total mining employment remained a very small fraction of all employment. Most mining activity was in sand and gravel operations supplying the construction industry.

Construction. Reflecting overall growth of the Delmarva economy and the high level of building activity associated with recreational development, construction employment increased by 42.9 percent between 1950 and 1970. As a proportion of all employment, however, construction employment was only one percentage point greater at the end of the period.

Manufacturing. In 1950, the manufacturing sector was the second largest employer on the Peninsula with total sector employment exceeded only by employment in agriculture, forestry, and fisheries. By 1970, however, the manufacturing sector was the primary employer - employing nearly one-quarter of the workers on the Delmarva Peninsula. Employment growth over the period totaled 11,677 or 40.5 percent. Subsector employment patterns showed some notable changes. The food manufacturing subsector, for example, had an increase in employment of 48.8 percent despite the precipitous decline of direct employment in agriculture. This was indicative of the continued importance of agriculture to the economy of the Peninsula and the changed nature of the agricultural output of the area. Vertically integrated broiler production became the dominant feature of Delmarva agriculture, particularly in the south half of the Peninsula. These firms provided employment in every stage of broiler raising and processing - from the hatchery to the final market. Other subsectors which demonstrated substantial employment growth were printing and publishing, machinery, and motor vehicles and transportation. Manufacturing employment in the lumber and wood products sub-sector, on the other hand, declined even more sharply than employment in the forestry sector.

Transportation, Communications, and Public Utilities. The relative increase in employment in this sector paralleled population growth over the period. Subsector employment trends, however, varied considerably. Employment in the railroad and express subsector, for example, decreased by 69.5 percent while the utilities subsector had an employment increase of 89.8 percent and the communications subsector increased 65.1 percent. The decline in railroad employment followed directly from the reduced importance of rail freight movement once highway access to the Peninsula was improved by the

opening of the Bay Bridge and other modernization projects. The growth of the communications and utilities subsectors reflected the underlying growth of the Peninsula's non-farm economy and increased standard of living.

Wholesale and Retail Trade. There were 31,143 workers employed in wholesale and retail trade in 1970. This sector accounted for nearly a fifth (19.0%) of Delmarva employment and had increased by 49.3% since 1950. Retail trade activity was most prevalent in areas of population concentration. Consequently, Dover and Salisbury became major retail trade centers because they possessed the largest urban areas in terms of population. Retail trade activity was also seasonally important along the Atlantic beaches, especially in Ocean City and Rehoboth Beach, and in other centers of recreation activity along the Chesapeake shoreline and throughout the Peninsula. Dover and Salisbury developed into important wholesaling centers, but wholesale trade activity also occurred in proximity to production centers for Peninsula exports, particularly broilers, seafood, and vegetables.

Finance, Insurance, and Real Estate. Employment in financial services was another indicator of the degree of growth experienced in the non-farm economy of the Delmarva Peninsula. Total employment in the sector doubled between 1950 and 1970 reflecting a high level of general business activity, increased personal income, and growth in the demand for seasonal and vacation homes.

Services. The largest absolute increase in sector employment between 1950 and 1970 occurred in the services sector. With 1970 employment of 35,601, the services sector was the second largest employer on the Peninsula, exceeded only by the manufacturing sector. Over the two decades, services employment increased by 16,733 or 88.7 percent. This increase alone was

sufficient to absorb more than 80 percent of the jobs lost in agriculture. Only one subsector, private households, showed a net decrease in employment. This decrease followed a national trend. Both the hotel subsector and the entertainment and recreation subsector experienced substantial growth in employment both in response to the increasing number of visitors to the area and in response to rising personal incomes and increased leisure time gained by the Peninsula population.

The most significant indicator of the growth of the Delmarva economy and the structural changes that were both a cause of growth and a consequence of growth was the change in medical and professional employment. Employment in this subsector, composed of medical services, legal services, education, and other professional services, more than tripled over the twenty-year period and had a large absolute increase as well - accounting for over 90 percent of the change in all service employment. Demand for professional services was a function of both population and income. The relatively small increase in Peninsula population over the same period explained only a fraction of the increase that actually occurred. In the post World War II years, however, increased personal incomes were used to purchase higher levels of services, both public and private. General levels of education and health care improved dramatically from 1950 to 1970 as a result of both higher standards and consumer preferences.

Public Administration. The growth of the government sector on the Peninsula was reflected by the substantial increase in employment in public administration. Sector employment more than doubled between 1950 and 1970. The growth of government employment was due to both the increased demand for social services and the expanded base of social overhead capital represented by bridges, highways, schools, courthouses, prisons, and other public

structures and institutions.

Armed Forces. The almost three-fold increase in armed forces employment resulted from the reactivation of Dover Air Force Base in 1951 and its subsequent growth. Dover AFB is the home base for the 36 C-5 Galaxies of the 436th Military Airlift Wing of the Military Airlift Command. The C-5, with a payload in excess of 80 tons, is the world's largest aircraft. These aircraft, along with the personnel and support facilities at Dover AFB, are an integral part of U.S. strategic airlift capability.

Overall, employment on the Peninsula grew very slowly in the years between 1950 and 1969. As detailed above, however, significant shifts in employment by industry sector did occur. Employment in agriculture, forestry, and fisheries declined by more than 50 percent, but increased employment in other sectors was sufficient to absorb both displaced workers in agriculture and new entrants in the Peninsula labor force. Total non-farm employment rose from 95,033 in 1950 to 148,799 in 1970, an increase of 56.6 percent. The employment statistics, however, grossly understated the economic growth on the Peninsula. Earnings data which reflected the effect of both increased employment and increased labor productivity provided a more accurate measure of growth.

Earnings

Peninsula earnings by industry sector for 1950 and 1969 are shown in Table 11.[1/] Also shown in Table 11 are the distributions of total earnings across industry sectors and the absolute and percentage changes in earnings between 1950 and 1969. Total earnings increased by 115.4 percent between

1/ Earnings are stated in 1967 dollars to correct for changes in the general price level between 1950 and 1969.

Table 11 - Earnings by industry, 1950 and 1969, and changes in industry earnings, 1950-1969, Delmarva Peninsula

	1950		1969		Change 1950-1969	
(in thousands of 1967 dollars)	Dollars	Percent of Total	Dollars	Percent of Total	Dollars	Percent
Agriculture, Forestry, and Fisheries	149,436	30.6	169,740	16.1	20,304	13.6
Mining	440	0.1	722	0.1	282	64.1
Contract Construction	23,581	4.8	48,148	4.6	24,567	104.2
Manufacturing	99,308	20.3	238,611	22.7	139,303	140.3
Transportation, Communications, and Utilities	26,359	5.4	52,312	5.0	25,953	98.5
Wholesale and Retail Trade	90,375	18.5	153,404	14.6	63,029	69.7
Finance, Insurance, and Real Estate	8,277	1.7	22,503	2.1	14,226	171.9
Services	40,298	8.2	106,414	10.1	66,116	164.1
Public Administration	39,560	8.1	205,091	19.5	165,531	418.4
Armed Forces	11,007	2.3	55,355	5.2	44,348	402.9
Delmarva Peninsula Total	488,641	100.0	1,052,300	100.0	563,699	115.4

Source: U.S. Department of Commerce, Bureau of Economic Analysis.

1950 and 1969 while employment in the comparable period grew by only 25.7 percent and population by only 25.4 percent. The resulting change in real per capita incomes was similarly dramatic (see Table 6).

Changes in earnings by industry sector between 1950 and 1969 presented some interesting contrasts with the employment data. For example, the agricultural sector had a 13.6 percent increase in earnings despite a 57.1 percent decrease in employment. The implied increase in productivity was the result of both the adoption of new technology and changed farm organization. Although the agricultural sector had an increase in earnings during the period, its share of total earnings fell from 30.6 percent to 16.1 percent. Earnings data above, however, understated the continued importance of agriculture in the Delmarva economy since other industry sectors are particularly dependent upon agriculture as a source of raw materials or as a market for finished goods. As Table 10 indicates, more than a third of all manufacturing employment (and, presumably, a similar function of earnings) was related to food packing and processing - primarily seafood, vegetables, and poultry. Similarly, a significant fraction of earnings in the trade, services, and other sectors flowed from the sale of inputs to agriculture.

Other notable differences between the change in earnings and the change in employment among sectors occurred in the two sectors most closely related to government expenditures - public administration and armed forces. Both of these sectors experienced an increase in real earnings in excess of 400 percent between 1950 and 1969. This was further evidence of the impact of government spending on the economic growth of the Peninsula. The increase in earnings in the two sectors was substantially greater than the underlying increases in employment. In the early years of the period, government workers, both civilian and military, were underpaid relative to comparable employees

in the private sector. The achievement of comparability occurred in the latter part of the period and was reflected in the earnings data for the two sectors.

While the Peninsula economy expanded rapidly during the years from 1950 to 1969, the national economy also grew. As the following data indicates, Peninsula earnings as a percent of U.S. earnings decreased between 1950 and 1959, but increased between 1959 and 1969:

Year	Delmarva Earnings - Percent of U.S. Total[1/]
1950	0.189
1959	0.172
1969	0.190

These statistics indicate that the national growth rate exceeded the Peninsula growth rate between 1950 and 1959 and that between 1959 and 1969 the Peninsula economy grew more rapidly than the national economy, as measured by earnings growth.

Wage Rates

For three decades the national growth of the labor force outpaced the creation of new jobs on the Peninsula. The consequences were both an out-migration of workers in search of employment and the exertion of downward pressure on the Delmarva wage rates. Table 12 shows median hourly earnings for selected occupations obtained during 1973 and 1977 area wage surveys by the Bureau of Labor Statistics of the U.S. Department of Labor. A small part of the Wilmington Standard Metropolitan Statistical Area (SMSA) was part of the study area (those portions of Cecil and New Castle Counties south of the C&D Canal), but the structure of the economy of the region would suggest

1/ Source: U.S. Department of Commerce, Bureau of Economic Analysis

Table 12--Representative wage rates for selected occupations, Delmarva Peninsula, 1973 and 1977

(Median hourly earnings)

Occupation	Lower Eastern Shore 1/		Wilmington SMSA 2/	
	1973	1977	1973	1977
Electronic technicians	$5.34	$6.69	$5.75	$8.00
Carpenters, maintenance	5.34	7.65	6.04	7.70
Machinists, maintenance	4.39	7.65	4.96	7.70
Mechanics, automotive (maintenance)	3.35	4.55	5.50	7.70
Mechanics, maintenance	5.34	7.65	5.03	7.10
Drafters	N.A.	4.70	N.A.	6.75
Truckdrivers, all	2.76	3.75	5.52	6.45
Secretaries	3.07	4.38	4.84	5.92
Truckers, power (forklift)	2.90	5.76	4.49	5.22
Computer operators	N.A.	5.50	N.A.	5.15
Switchboard operators	2.38	2.94	3.27	4.33
Laborers, material handling	2.97	3.15	3.52	4.20
Stenographers, general	2.69	3.61	3.28	4.05
Keypunch operators, class B	2.40	3.50	3.19	3.95
Typists, class B (routine copy typists)	2.31	3.05	2.95	3.62
Janitors, porters and cleaners	2.35	3.33	2.95	2.75
Guards and watchmen	2.10	2.30	3.03	2.45

N.A. indicates not available.

1/ Somerset, Wicomico, and Worcester counties, Maryland; Accomack and Northampton counties, Virginia; and Sussex County, Delaware

2/ New Castle County, Delaware; Salem County, New Jersey; and Cecil County, Maryland

Source: U.S. Department of Labor, Bureau of Labor Statistics, Area Wage Surveys

that the wage rates in the lower half of the Peninsula were more representative of the Peninsula as a whole. In any case, considerable variation in local wage rates existed due to labor market conditions.

Between 1950 and the early 1970's, despite the growth in the economy during the latter part of the period, a labor surplus remained in the area. In 1973 hourly wages for both male and female workers averaged 20-25 percent lower in the southern part of the Peninsula than in the Wilmington SMSA. With one exception - maintenance mechanics skilled in agricultural equipment repair - wage rates were lower for every occupation, both male and female, in the lower shore area.

Between 1973 and 1977 the wage structure on the lower Peninsula changed somewhat. This may have been attributable, in part, to the fact that there was a moderate improvement in new job creation, the region experienced a modest net migration gain, and the economy of the area continued to experience steady growth.

In 1977 wage rates in the Wilmington SMSA still generally exceeded those in the lower Peninsula. Interestingly, in several categories - electronic technicians, auto mechanics, and material handlers - the 1977 wage differentials were greater than those in 1973. However, the average wage differential between the Lower Eastern Shore and the Wilmington SMSA in 1977 decreased to less than twenty percent. Wage rates were at or near parity in several occupational categories - the most notable being carpenters and machinists. In four of the seventeen categories - maintenance mechanics; computer operators; forklift drivers; and janitors, porters, and cleaners - wage rates in the Lower Eastern Shore area exceeded those in the Wilmington SMSA.

Conditions in the labor market - high demand and short supply - may have accounted for the relatively higher wage rate for skilled maintenance mechanics and forklift operators on the Peninsula. Additional monetary compensation may have been necessary to induce highly trained computer operators to locate on the relatively rural Delmarva Peninsula - a region lacking some of the amenities of more highly urbanized metropolitan areas. Between 1973 and 1977 an oversupply of relatively unskilled workers depressed the average hourly wage rate for janitors, porters, and cleaners 6.8 percent - from \$2.95 to \$2.75 - in the Wilmington SMSA. During an identical time period, the average wage rate for the same type of activity on the Lower Eastern Shore increased over 40 percent from \$2.35 to \$3.33. This combination of factors enabled janitors, porters, and cleaners on the Peninsula to earn over 20 percent more in wages than their counterparts in the Wilmington SMSA in 1977.

AGRICULTURE

Despite an appreciable decrease in farm employment and share of earnings since 1950, the agricultural sector continues to provide a substantial number of employment and income opportunities. Agriculture still remains the major economic force within the Delmarva Peninsula supporting an agri-business complex that includes hatcheries, feed mills, and processing plants of integrated broiler firms; vegetable canning and freezing plants; and suppliers of machinery, fertilizer, and other farm inputs. Numerous individuals are employed and receive income directly from agriculture and allied industries for performing tasks primarily associated with producing, harvesting, and marketing farm and farm-related products. In addition, the agricultural sector indirectly generates other employment and income opportunities. Many individuals are employed by and receive income from business concerns which supply the non-farm goods and services demanded by the agricultural sector. The total amount of jobs and earnings that can be directly or indirectly attributed to agriculture and related industries is substantial and only partly indicated by statistics of the agricultural sector *per se*. The continuing viability of Delmarva agriculture contrasts sharply with other parts of the Northeast where agriculture has been displaced by residential and commercial development and by changes in national production patterns. As the data presented below indicates, Delmarva agriculture has been subjected to similar pressures.

Because the portions of Cecil and New Castle counties that are part of the survey area are primarily agricultural, data for these two counties as a whole have been included in the analysis. In addition, data for the Upper and Lower Shore areas of Maryland are presented separately to reflect the differences in climate, soils, and type of farming that distinguish the two areas.

Farm Characteristics

Following national trends, the Delmarva Peninsula experienced a considerable decrease in the number of farms between 1959 and 1974 and a moderate decrease in the acreage of land in farms (Table 13).[1/] Average farm size increased by 35 percent from 156.7 acreas in 1959 to 212 acres in 1974. The decline in the number of farms was the direct result both of the adoption of labor-saving technology with its accompanying increase in the size of optimal management units and of the availability of off-farm employment opportunities. The acreage of land in farms decreased for two distinct but related reasons. Land will be used for agricultural purposes only when returns to land in agriculture exceed the return in competing uses. Some land in farms on the Peninsula was lost to residential, commercial, and industrial development despite its relatively high agricultural value. The remaining decrease in farm acreage resulted from changes in agricultural values that led to either outright abandonment or a change to less intensive use.

Average size of farm in 1974 varied considerably among Peninsula counties ranging between 120 acres in Wicomico County, Maryland, to 391 acres in Kent County, Maryland. Farms in the Upper Shore area of Maryland were of a considerably larger average size than those of the Lower Shore. The greatest change in average size between 1959 and 1974 occurred in Accomack County, Virginia, where a 48 percent decrease in farm numbers and only a 14 percent decrease in land in farms resulted in a 65 percent increase in average farm size. Figure D further illustrates Peninsula trends in number of farms, land in farms, and average size of farm.

1/ For a detailed explanation of the 1959 and 1974 Census of Agriculture definitions of a farm, differences, and effect on the comparability of data, please refer to Appendix A on page 113.

Table 13 - Number of farms, land in farms, and average size of farm, Delmarva Peninsula, 1959, 1964, 1969, and 1974.

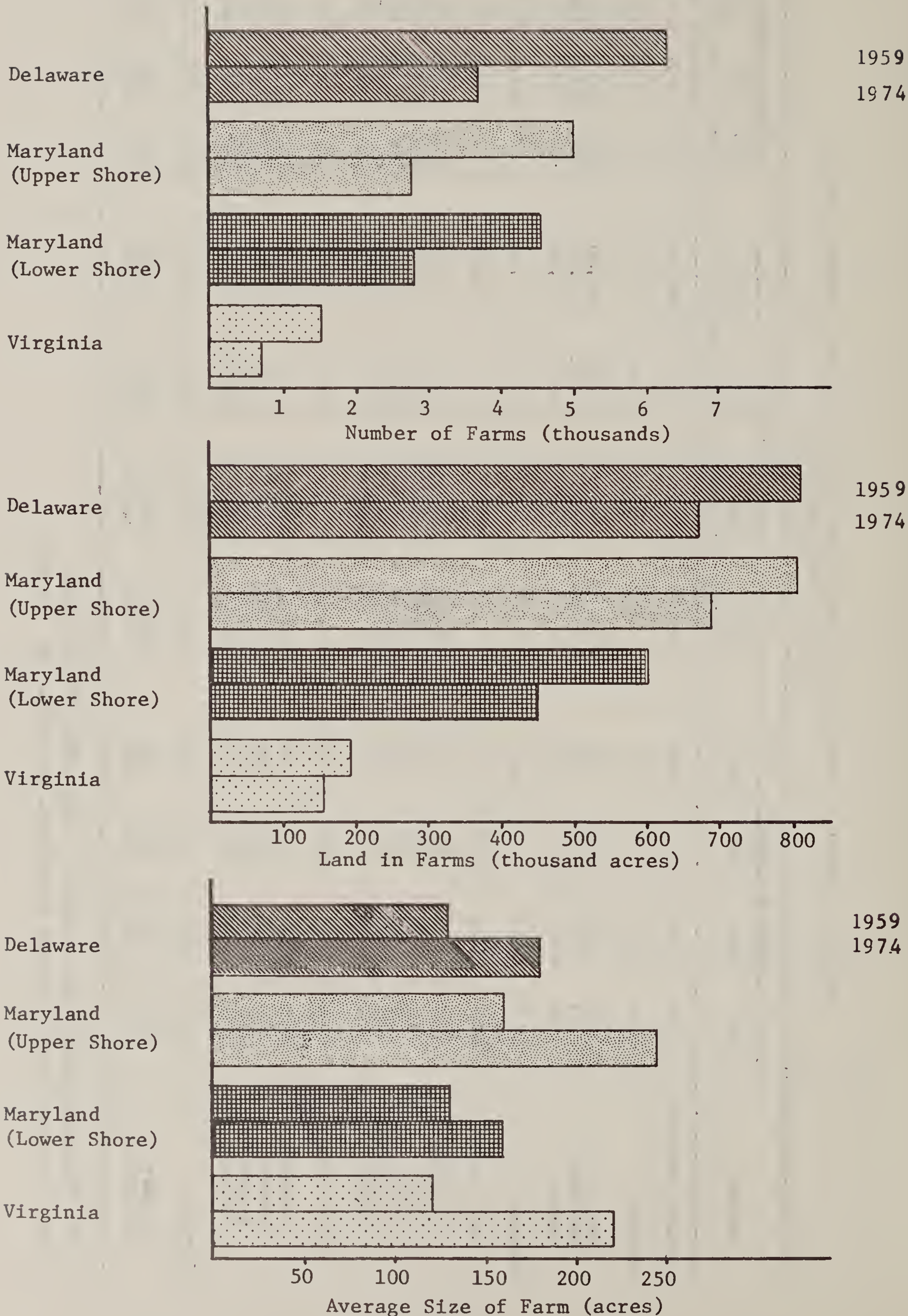
Subarea	Number of farms [1]				Land in farms [1]				Average size of farm			
	1959	1964	1969	1974	1959	1964	1969	1974	1959	1964	1969	1974
					Acres				Acres			
Delmarva Peninsula	14,220	11,605	10,041	8,876	2,228,790	2,097,216	1,970,755	1,880,426	156.7	180.7	196.3	212
Delaware	5,208	4,401	3,710	3,400	762,526	717,015	673,895	630,605	146.4	162.9	181.6	185
Kent	1,533	1,219	1,073	976	251,834	232,125	219,788	196,410	164.3	190.4	204.8	201
New Castle	739	564	516	432	129,650	121,055	113,251	100,172	175.4	214.6	219.4	232
Sussex	2,936	2,618	2,121	1,992	380,942	363,835	340,856	334,023	129.7	139.0	160.7	168
Maryland	7,837	6,199	5,624	4,826	1,287,007	1,205,970	1,140,669	1,095,429	164.2	194.5	202.8	227
Upper Shore	3,929	3,125	2,816	2,443	766,219	721,064	690,655	652,212	195.0	230.7	245.3	267
Caroline	1,177	923	817	740	156,771	144,855	132,782	128,788	133.2	156.9	162.5	174
Cecil	832	659	541	480	138,649	127,455	113,710	99,158	166.6	193.4	210.1	207
Kent	538	470	488	352	149,968	145,865	148,420	137,458	278.8	310.4	304.1	391
Queen Annes	812	641	551	497	182,772	177,695	170,589	166,087	225.1	277.2	309.5	334
Talbot	570	432	419	374	133,059	125,195	125,154	120,721	242.2	289.8	298.6	323
Lower Shore	3,908	3,074	2,808	2,383	520,788	484,905	450,014	443,217	133.3	157.7	160.3	186
Dorchester	729	616	516	456	157,050	150,065	139,583	147,302	215.4	243.6	270.5	323
Somerset	663	573	470	435	85,528	78,610	69,744	69,618	129.0	137.2	148.3	160
Wicomico	1,418	1,061	1,037	851	131,363	116,475	112,545	102,523	92.6	109.8	108.5	120
Worcester	1,098	824	785	641	146,847	139,755	128,142	123,774	133.7	169.6	163.2	193
Virginia	1,175	1,005	707	650	179,257	174,231	156,191	154,392	152.6	173.4	220.9	238
Accomack	805	690	466	420	112,191	114,185	105,031	96,708	139.4	165.5	225.3	230
Northampton	370	315	241	230	67,066	60,046	51,160	57,684	181.3	203.3	212.2	251

1 See Census definition of land in farms for 1959, 1964, 1969, and 1974.

Source: Bureau of Census, Census of Agriculture, 1959, 1964, 1969, and 1974.

Figure D

Delmarva Farm Trends
1959 – 1974



The statistics presented in Table 14 on type of farm indicate the changes in Delmarva agriculture that occurred between 1959 and 1974 and the distribution of farm types across Peninsula subareas. In 1959, the predominate farm types were poultry, cash-grain, dairy, and general farms, in that order, with distinct differences among the subareas in the distribution of these types. In the Delaware subarea, poultry farms were the predominate farm type followed by cash-grain and dairy farms. In the Upper Shore subarea, dairy farms predominated with cash-grain and poultry farms being secondary specialties. The ranking in the Lower Shore was poultry, cash-grain, and general farms. In the Virginia subarea, poultry and cash-grain farms predominated. Interestingly, there were only 10 dairy farms in the Virginia subarea in 1959 and only slightly more than 100 in the Lower Shore subarea of Maryland.

By 1974, cash-grain farms had become the most numerous type of farm on the Peninsula followed closely by poultry farms. In 1959, these two types comprised 40.5 percent of all Delmarva farms, but by 1974, had almost doubled, with 79.1 percent of all farms being devoted to either cash-grain or poultry production. The number of dairy and general farms on the Peninsula decreased by over half both in absolute and percentage terms. Dairy operations ceased to exist entirely in Virginia. Cash-grain and dairy farms continued to be most prevalent in the northern half of the Peninsula with poultry and cash-grain farms predominating in the southern half. Vegetable farms, while decreasing in absolute number on the Peninsula, actually increased in percentage terms in Delaware and Virginia. While cash-grain farms predominate, 12.1 percent of all farms in Virginia are devoted to vegetable production.

The tenure of farm operators in 1974 is illustrated in Figure E. For the Peninsula as a whole, 59.4 percent of all operators were full owners,

Table 14 - Type of farm and percent distribution, Delmarva Peninsula and subareas, 1959 and 1974.

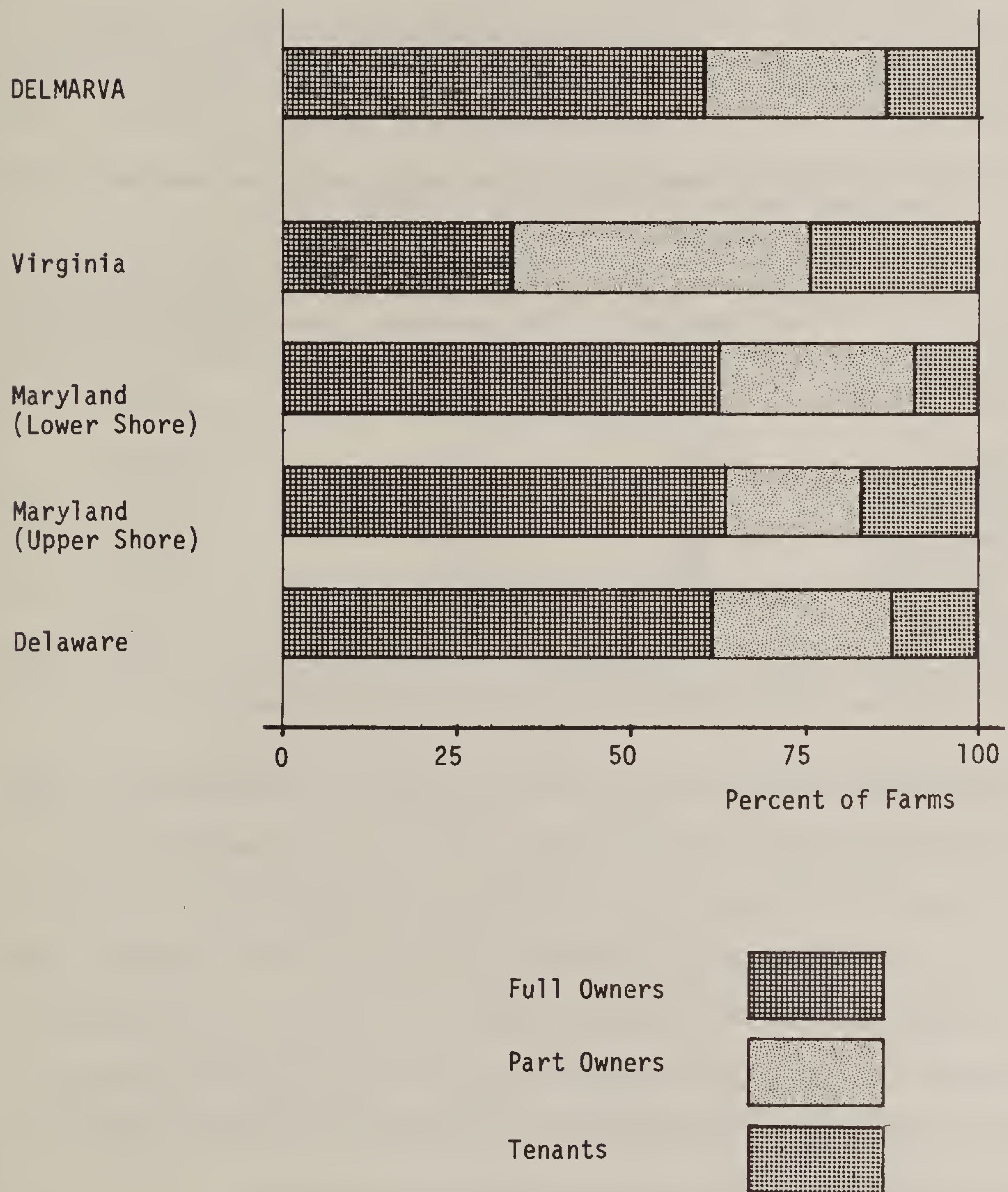
Item	Delmarva		Delaware		Maryland		Maryland Upper Shore		Maryland Lower Shore		Virginia	
	1959	1974	1959	1974	1959	1974	1959	1974	1959	1974	1959	1974
All farms	14,221	7,896	5,203	2,988	7,758	4,323	3,863	2,117	3,895	2,206	1,260	585
Cash-grain	2,643	3,393	980	1,414	1,545	2,209	807	1,297	738	912	118	270
Dairy	1,951	501	728	167	1,213	334	1,105	312	108	22	10	0
Poultry	3,258	2,354	1,526	1,004	1,595	1,281	366	208	1,229	1,073	137	69
Other livestock	488	301	145	114	321	175	228	123	93	52	22	12
Vegetable	419	241	106	70	204	100	54	47	150	53	109	71
General	822	186	269	52	469	104	261	50	208	54	84	30
All other	4,640	420	1,449	167	2,411	120	1,042	80	1,369	40	780	133
	Percent											
All farms	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Cash-grain	18.6	49.3	18.8	47.3	19.9	51.1	20.9	61.3	19.0	41.3	9.4	46.2
Dairy	13.7	6.3	14.0	5.6	15.6	7.7	28.6	14.7	2.8	1.0	.8	.0
Poultry	22.9	29.8	29.3	33.6	20.6	29.6	9.4	9.8	31.6	48.6	10.9	11.8
Other livestock	3.4	3.8	2.8	3.8	4.1	4.1	5.9	5.8	2.4	2.4	1.7	2.1
Vegetable	3.0	3.1	2.0	2.4	2.6	2.3	1.4	2.2	3.8	2.4	8.6	12.1
General	5.8	2.4	5.2	1.7	6.1	2.4	6.8	2.4	5.3	2.5	6.7	5.1
All other	32.6	5.3	27.9	5.6	31.1	2.8	27.0	3.8	35.1	1.8	61.9	22.7

Source: Bureau of the Census, Census of Agriculture, 1959 and 1974

Figure E

Delmarva Farm Tenure

1974



28.2 percent were part owners, and 12.4 percent were tenants. Subareas exhibited little variation in tenure pattern with the exception of the Virginia subarea where full owners comprised only 38.5 percent of all farm operators with part owners and tenants a more common form of tenure than in the remainder of the Peninsula.

Despite the continued viability of Delmarva agriculture, a sizable number of farm operators reported off-farm work in 1974 (Table 15).

Table 15--Farm operators reporting off-farm work, number and percent of all operators, Delmarva Peninsula and subareas, 1974

Subarea	Reporting all off-farm work	Percent of all farm operators	Reporting off-farm work of 100 days or more
DELMARVA PENINSULA	3,381	39.2	3,051
Delaware	1,387	41.9	1,174
Maryland:	1,832	39.0	1,494
Upper Shore	934	39.3	743
Lower Shore	898	38.8	751
Virginia	162	26.0	125

Source: Bureau of the Census, 1974 Census of Agriculture

Approximately 39 percent of all farm operators worked off-farm in 1974. While almost 42 percent reported off-farm work in the Delaware subarea, only 26 percent of all operators in the Virginia subarea were similarly employed. For the Peninsula as a whole, 83 percent of those reporting off-farm work were employed for 100 days or more. The seasonality of labor requirements for cash-grain production and the labor required to manage a modern broiler house are both amenable to part time or full time work in non-farm occupations where job opportunities are available.

Crop and Livestock Production

The economic importance of agriculture on the Peninsula is illustrated in Table 16. Sales of all farm products in 1974 totaled 616.9 million dollars, an increase of 165.9 percent over 1959. Sales of all crops accounted for about one-third of total sales with sales of livestock, poultry, and dairy products accounting for the remaining two-thirds. Crop sales increased by 151.7 percent between 1959 and 1974 with field crop sales exhibiting the largest absolute and percentage increases in sales. All crops had a net sales increase of at least 140 percent except for fruits and nuts which experienced a 9 percent rise in sales. Livestock and dairy product sales more than doubled between 1959 and 1974. The major portion of the rise was due to increased sales of poultry and poultry products. Of all livestock and dairy products only the Other Livestock and Products category had a net decrease in sales over the period.

The distribution of crop and livestock sales over the Peninsula subareas reflected the increased importance of cash-grain and poultry production and the decreased importance of dairy production. Increased sales of all crops were particularly notable in the Upper Shore subarea where field crop sales rose five times while sales of forest products and horticultural specialties increased a phenomenal 540 percent. The Lower Shore subarea had an increase in sales of poultry and poultry products of 268 percent over the 1959 to 1974 period and all subareas except the Upper Shore of Maryland more than doubled sales of livestock sold alive.

Crop Production. Production of all major crops increased between 1959 and 1974 with the exception of all hay and sweet potatoes (Table 17). Wheat, corn, and soybean production increased by 96.8 percent, 88.1 percent, and 86.5

Table 16--Sales of farm products, 1959 and 1974, and percent change in sales, 1959-1974, Delmarva Peninsula and subareas

Item	Delmarva Peninsula		Delaware		Maryland		Md. Upper Shore		Md. Lower Shore		Virginia	
	1959	1974 1/	1959	1974 1/	1959	1974 1/	1959	1974 1/	1959	1974 1/	1959	1974 1/
	Thousand dollars											
All Farm Products:	232,047	616,923	94,262	250,158	117,350	313,333	52,067	150,536	65,283	162,797	20,435	53,432
All Crops--	78,587	277,804	26,791	87,486	35,150	146,904	16,963	85,495	18,187	61,409	16,646	43,414
Field Crops	53,559	236,010	18,085	72,964	25,425	130,925	13,388	76,438	12,037	54,487	10,049	32,121
Vegetables	16,269	39,436	4,572	13,332	6,364	14,925	2,806	8,518	3,558	6,407	5,333	11,179
Fruits & Nuts	2,107	2,296	656	1,190	794	991	167	477	627	514	657	115
Forest & Hort. Spec.	6,649	16,542	3,478	6,178	2,565	8,727	602	3,857	1,964	4,870	506	1,637
Livestock & Dairy--	150,067	381,023	67,471	156,493	79,413	216,149	34,502	61,183	44,911	154,966	3,183	8,381
Livestock Sold Alive 2/	12,109	23,201	3,846	8,613	7,847	13,740	5,809	8,019	2,038	5,721	416	848
Dairy Products	19,475	31,882	8,301	8,783	11,097	23,099	9,667	21,337	1,430	1,762	77	--
Poultry & Products	98,967	323,754	47,012	138,337	49,348	178,005	9,344	30,803	40,004	147,202	2,607	7,412
Other Livestock & Prod.	19,516	1,968	8,312	760	11,121	1,204	9,682	1,024	1,439	180	83	4
	Percent											
All Farm Products:	165.9		165.4		167.0		189.1		149.4		161.5	
All Crops--	253.5		226.5		317.9		403.5		237.7		160.8	
Field Crops	340.7		303.5		414.9		470.9		352.7		219.6	
Vegetables	142.4		191.6		134.5		203.6		80.1		109.6	
Fruits & Nuts	9.0		81.4		24.8		185.6		-18.0		-82.5	
Forest & Hort. Spec.	148.8		77.6		240.2		540.7		148.0		170.1	
Livestock & Dairy	153.9		131.9		172.2		77.3		245.1		163.3	
Livestock Sold Alive 2/	91.6		123.9		75.1		38.0		180.7		103.8	
Dairy Products	63.7		5.8		108.2		120.7		23.2		-100.0	
Poultry & Products	227.1		194.3		260.7		229.7		268.0		184.3	
Other Livestock & Prod.	-89.9		-90.9		-89.2		-89.4		-87.5		-95.2	

1/ 1974 data is for Class 1-5 farms. These farms accounted for more than 99% of the sales of all farm products in 1974.
2/ Cattle & Calves, Hogs & Pigs, Sheep & Goats
Source: Bureau of Census, Census of Agriculture, 1959 and 1974.

Table 17--Production of major crops, 1959 and 1974, and percent change in production, 1959 to 1974, Delmarva Peninsula and subareas.[1/]

Crop	Unit	Delmarva Peninsula 1959	Delmarva Peninsula 1974	Delaware 1959	Delaware 1974	Maryland 1959	Maryland 1974	Md. Upper Shore 1959	Md. Upper Shore 1974	Md. Lower Shore 1959	Md. Lower Shore 1974	Virginia 1959	Virginia 1974
Corn[1/]	1,000 bu.	20,650.0	38,835.8	7,038.2	10,756.0	13,175.1	27,138.0	8,683.4	16,731.1	4,491.7	10,406.9	436.7	941.8
Wheat	1,000 bu.	2,481.3	4,883.3	617.9	1,447.5	1,826.4	2,737.8	1,511.6	2,237.9	314.8	499.9	37.0	698.0
Small Grains[1/]	1,000 bu.	3,016.4	3,626.2	905.9	1,218.6	1,967.7	2,217.9	1,369.2	1,283.4	598.5	934.5	142.8	189.7
Soybeans	1,000 bu.	8,281.9	15,447.4	3,246.2	5,386.5	4,176.6	8,575.3	1,471.7	4,709.9	2,704.9	3,865.4	859.1	1,485.6
All Hay	100 tons	2,075.4	1,274.6	621.4	416.2	1,419.8	844.8	1,195.6	727.9	224.2	116.9	34.2	13.5
Irish Potatoes	1,000 cwt.	4,308.9	4,427.6	1,611.9	1,282.3	366.5	111.9	119.1	22.9	247.3	88.9	2,330.5	3,033.4
Sweet Potatoes	1,000 bu.	3,719.2	1,576.5	42.2	17.7	882.2	288.0	14.0	20.1	868.2	267.9	2,794.8	1,270.8

---------- Percent ----------

Crop	Delmarva Peninsula	Delaware	Maryland	Md. Upper Shore	Md. Lower Shore	Virginia
Corn	88.1	52.8	106.0	92.7	131.7	115.7
Wheat	96.8	134.3	49.9	48.0	58.8	1,786.5
Small Grains	20.2	34.5	12.7	-6.3	56.1	32.8
Soybeans	86.5	65.9	105.3	220.0	42.9	72.9
All Hay	-38.6	-33.0	-40.5	-39.1	-47.9	-60.5
Irish Potatoes	2.8	-20.4	-69.5	-80.8	-64.1	30.2
Sweet Potatoes	-57.3	-58.1	-67.4	-43.6	-69.1	-54.5

1/ 1974 production from farms with sales of $2,500 and over.

Source: Bureau of Census, Census of Agriculture, 1959 and 1974.

percent, respectively. The Upper Shore subarea had a three-fold increase in soybean production mirroring the shift to grain production noted above. Wheat production doubled on the Peninsula with the Virginia subarea experiencing a phenomenal increase of 1,786.5 percent. This rise, along with the increase of 52.8 percent in small grain production in the Virginia subarea, reflects the adoption of double cropping of winter wheat and barley with vegetable crops and the use of two-year rotations of corn, winter grain, and soybeans. Multiple crop rotations are also being adopted in the Lower Shore subarea. Total Irish potato production on the Peninsula increased 2.8 percent between 1959 and 1974. Interestingly, every subarea except Virginia experienced at least a 20 percent decrease in Irish potato production. In Virginia, Irish potato production increased 30.2 percent. By 1974 nearly seven of every ten Irish potatoes produced on the Delmarva Peninsula were grown in Virginia.

Data on the acreage of major crops as a percent of harvested cropland are presented in Table 18. Corn and soybeans were grown on 84 percent of harvested cropland in 1974 as opposed to 63 percent in 1959. The proportions of cropland devoted to all other crops except wheat decreased between 1959 and 1974. Cropping patterns in 1974 were similar across Delmarva subareas with the exception of the Virginia subarea. In the two Virginia counties, 41 percent of harvested cropland was devoted to production of vegetables, Irish potatoes, and sweet potatoes. Soybeans were grown on an additional 48 percent of cropland, wheat on 13 percent, and only 8 percent of cropland was in corn.

Major crop acreages by county for Census years between 1959 and 1974 are presented in Table 19. These data give a further indication of the general

Table 18--Acreages of major crops as a percent of harvested cropland, 1959 and 1974, Delmarva Peninsula and subareas

Crop	Delmarva Peninsula		Delaware		Maryland		Maryland Upper Shore		Maryland Lower Shore		Virginia	
	1959	1974	1959	1974	1959	1974	1959	1974	1959	1974	1959	1974
All Corn	34.5	36.9	35.5	35.1	38.3	42.4	40.7	42.7	34.5	42.0	7.5	8.4
Corn for Grain	32.7	35.0	33.9	33.4	36.0	40.2	37.6	39.4	33.6	41.4	7.2	8.1
Corn for Silage	1.6	1.9	1.4	1.7	2.0	2.2	2.9	3.3	.7	.6	.2	.3
Soybeans for Beans	28.8	47.4	33.8	46.5	25.0	47.8	14.3	36.0	41.6	67.0	33.1	47.9
Wheat	7.9	9.7	5.8	9.1	10.3	9.4	14.0	12.2	4.5	4.8	1.1	13.7
Small Grains	7.9	6.1	7.0	6.3	8.9	6.4	9.8	5.7	7.5	7.4	5.5	3.8
Vegetables for Sale	10.6	6.8	10.1	7.5	8.1	4.7	6.3	5.1	10.8	4.1	27.9	17.5
Irish Potatoes	2.5	2.2	1.9	1.4	.4	.1	.1	*	.8	.2	17.7	18.8
Sweet Potatoes	1.5	.5	.1	*	.5	.1	*	*	1.3	.3	13.6	4.6
All Other Crops 1/	6.3	-9.6	5.8	-5.9	8.5	-11.2	14.8	-1.7	-1.0	-25.8	-6.4	-14.7

1/ Totals may not add up to 100% and/or negative percentages may occur due to double cropping - especially of soybeans, wheat, and small grains.

* Indicates not available.

Source: Bureau of Census, Census of Agriculture, 1959 and 1974.

Table 19--Harvested acreage of major crops, Delmarva Peninsula, 1959, 1964, 1969, and 1974.

Area	All Corn				Corn for Grain				Corn Silage			
	1959	1964	1969	1974	1959	1964	1969	1974	1959	1964	1969	1974
	Acres											
DELMARVA PENINSULA	414,008	455,565	513,918	486,097	392,345	418,163	489,638	461,332	19,691	34,290	24,280	24,765
Delaware:	147,737	161,512	180,353	158,655	141,261	150,849	172,817	150,931	5,954	9,857	7,536	7,724
Kent	43,911	52,479	48,471	40,049	40,653	47,237	45,144	36,236	3,100	4,903	3,327	3,813
New Castle	21,451	22,883	26,684	20,914	19,491	19,796	24,784	18,892	1,901	2,963	1,900	2,022
Sussex	82,375	86,150	105,198	97,692	81,117	83,816	102,889	95,803	953	1,991	2,309	1,889
Maryland:	258,204	286,041	324,876	317,789	243,307	259,649	308,463	301,042	13,523	24,212	16,413	16,747
Upper Shore--	167,654	185,324	197,805	197,818	154,967	161,673	183,218	182,679	11,751	22,439	14,587	15,139
Caroline	28,435	32,871	31,599	26,737	26,537	29,322	29,483	25,092	1,610	3,224	2,116	1,645
Cecil	21,936	23,370	26,821	26,252	19,029	18,274	21,863	20,901	2,873	4,941	4,958	5,351
Kent	38,229	41,120	45,288	52,702	35,599	35,482	41,992	48,982	2,558	5,424	3,296	3,720
Queen Anne's	42,773	47,521	54,516	56,517	39,354	40,571	51,457	53,242	3,127	6,499	3,059	3,275
Talbot	36,281	40,442	39,581	35,610	34,448	38,024	38,423	34,462	1,583	2,351	1,158	1,148
Lower Shore--	90,550	100,717	127,071	119,971	88,340	97,976	125,245	118,363	1,772	1,773	1,826	1,608
Dorchester	27,073	32,089	40,669	35,750	26,563	31,326	40,157	35,300	502	728	512	450
Somerset	10,652	9,969	16,766	16,874	9,999	9,314	16,327	16,354	541	455	439	520
Wicomico	22,200	23,590	29,318	27,368	21,913	23,024	29,213	27,129	107	148	105	239
Worcester	30,625	35,069	40,318	39,979	29,865	34,312	39,548	39,580	622	442	770	399
Virginia:	8,067	8,012	8,689	9,653	7,777	7,665	8,358	9,359	214	221	331	294
Accomack	6,242	5,925	7,365	8,215	6,012	5,730	7,097	7,928	182	120	268	287
Northampton	1,825	2,087	1,324	1,438	1,765	1,935	1,261	1,431	32	101	63	7

Continued

Table 19--Harvested acreage of major crops, Delmarva Peninsula, 1959, 1964, 1969, and 1974.

	Soybeans for Beans				Wheat				Small Grains			
	1959	1964	1969	1974	1959	1964	1969	1974	1959	1964	1969	1974
	Acres											
DELMARVA PENINSULA	344,615	395,384	364,886	623,074	94,753	74,490	68,021	127,396	95,105	93,596	86,158	80,828
Delaware:	140,643	147,720	142,711	209,977	23,958	18,494	17,377	41,216	29,414	29,702	29,358	28,600
Kent	44,292	54,226	52,917	66,252	10,474	7,529	6,627	13,355	12,889	11,974	12,472	10,272
New Castle	5,972	12,943	17,281	31,451	8,762	7,893	7,378	9,435	5,285	5,396	3,757	2,048
Sussex	90,379	80,551	72,513	112,274	4,722	3,072	3,372	18,426	11,240	12,332	13,129	16,280
Maryland:	168,272	199,299	185,705	358.085	69,605	55,003	48,825	70,480	59,778	58,180	50,217	47,891
Upper Shore--	58,949	89,903	91,734	166,867	57,702	45,437	41,302	56,803	40,185	38,101	30,994	26,662
Caroline	27,925	34,327	31,373	49,565	10,518	8,304	7,137	12,274	9,329	10,523	10,877	11,550
Cecil	915	4,098	5,746	10,840	7,080	6,035	5,422	6,782	6,392	4,248	3,628	3,172
Kent	5,584	11,317	15,735	25,517	10,611	8,577	8,548	10,218	6,654	6,001	5,276	3,530
Queen Anne's	9,698	18,766	20,739	41,419	15,141	12,725	11,712	16,723	10,203	9,826	6,993	5,344
Talbot	14,827	21,395	18,141	39,526	14,352	9,796	8,483	10,806	7,607	7,503	4,220	3,066
Lower Shore--	109,323	109,396	93,971	191,218	11,903	9,566	7,523	13,677	19,593	20,079	19,223	21,229
Dorchester	36,860	34,517	32,610	54,184	9,892	8,381	6,890	9,597	9,053	10,291	10,554	13,525
Somerset	13,748	16,404	15,811	18,663	607	388	223	960	2,510	2,356	2,253	2,443
Wicomico	35,139	31,971	24,673	34,592	323	320	255	2,153	3,753	4,460	4,129	3,148
Worcester	23,576	26,504	20,877	29,595	1,081	477	155	967	4,277	2,972	2,287	2,113
Virginia:	35,700	48,365	36,470	55,012	1,190	993	1,819	15,700	5,913	5,714	6,583	4,337
Accomack	28,688	36,858	28,231	35,487	1,032	694	1,201	6,860	2,900	3,665	5,081	2,732
Northampton	7,012	11,507	8,239	19,525	158	299	618	8,840	3,013	2,049	1,502	1,605

Continued

Table 19--Harvested acreage of major crops, Delmarva Peninsula, 1959, 1964, 1969, and 1974. (Continued)

Area	Vegetables for Sale				Irish Potatoes				Sweet Potatoes			
	1959	1964	1969	1974	1959	1964	1969	1974	1959	1964	1969	1974
	Acres											
DELMARVA PENINSULA	126,557	122,761	108,366	88,990	29,774	30,380	34,784	28,574	18,438	15,824	12,078	6,297
Delaware:	42,135	43,805	39,234	33,722	8,056	8,065	7,658	6,247	215	106	143	48
Kent	14,658	10,060	11,436	14,169	5,862	5,517	5,881	5,226	28	13	11	8
New Castle	4,280	4,954	3,581	1,910	1,989	2,401	1,688	870	0	3	0	0
Sussex	23,197	28,791	24,217	17,643	205	147	89	151	187	90	132	40
Maryland:	54,347	50,915	45,657	35,165	2,657	1,659	1,237	769	3,541	2,675	2,121	950
Upper Shore--	26,015	27,134	27,019	23,571	609	410	325	122	65	39	125	13
Caroline	9,097	10,922	9,207	7,787	100	1	2	5	28	14	115	5
Cecil	2,096	1,679	2,124	1,047	224	227	140	103	0	0	0	0
Kent	7,665	8,109	9,406	9,396	210	176	165	1	0	0	0	2
Queen Anne's	3,572	3,363	3,736	3,803	73	5	18	5	37	25	10	6
Talbot	3,585	3,061	2,546	1,538	2	1	0	8	0	0	0	0
Lower Shore--	28,332	23,781	18,638	11,594	2,048	1,249	912	647	3,476	2,636	1,996	937
Dorchester	10,815	10,320	6,209	4,267	21	18	5	4	104	106	142	85
Somerset	5,137	3,691	2,671	2,092	511	456	188	6	49	10	0	0
Wicomico	7,796	6,177	6,557	3,916	126	265	156	6	2,645	2,154	1,656	830
Worcester	4,584	3,593	3,201	1,319	1,390	510	563	631	678	366	198	22
Virginia:	30,075	28,041	23,475	20,103	19,061	20,656	25,889	21,558	14,682	13,043	9,814	5,299
Accomack	9,934	11,891	11,671	9,545	9,941	11,448	16,275	13,298	10,242	7,846	5,591	2,194
Northampton	20,141	16,150	11,804	10,558	9,120	9,208	9,614	8,260	4,440	5,197	4,223	3,105

Source: Bureau of Census, Census of Agriculture, 1959, 1964, 1969, and 1974.

trend on the Peninsula: the increased production of soybeans and wheat; the continuing importance of corn; and the declining trend in vegetable and sweet potato production.

Livestock Production. Livestock inventory and sales numbers by county for 1959 and 1974 are presented in Table 20. With the exception of hogs and pigs, inventory numbers of livestock decreased by at least 32 percent in all categories between 1959 and 1974. The decline in the number of milk cows reflects both the decreasing importance of dairying on the Peninsula and the national trend. Decreases in inventories of cattle and calves, sheep and lambs, and horses and ponies resulted from the increasing specialization of Delmarva agriculture in cash-grain and poultry production and the subsequent decline in general farming. The decrease in the number of horses and ponies was moderated by the increasing popularity of pleasure horses, particularly in suburban areas. In Cecil County, for example, the number of horses and ponies on farms in 1974 was 48.5 percent higher than the 1959 statistic. Sales of cattle and calves and of sheep and lambs decreased considerably between 1959 and 1974, paralleling the decrease in inventory numbers.

In contrast, sales of hogs and pigs increased by 57 percent over the same period although the number of hogs and pigs in inventory was essentially the same in 1974 as it was in 1959. Producers have succeeded in increasing pigs farrowed per sow and reducing the time needed to raise a pig to market weight thereby increasing sales without a parallel increase in inventory. To some extent, the continuing growth of swine production is the result of increases in poultry production since hatchery and processing plant wastes are a ready source of animal protein for hog rations. As the county data indicates, in most cases, the greatest increases in hog sales between 1959

Table 20--Inventories and sales of livestock and poultry, Delmarva Peninsula, 1959 and 1974

Area	Cattle and Calves 1/				Hogs and Pigs				Sheep and Lambs			
	Inventory		Sales		Inventory		Sales		Inventory		Sales	
	1959	1974	1959	1974	1959	1974	1959	1974	1959	1974	1959	1974
DELMARVA PENINSULA	162,635	102,144	76,450	45,346	124,655	124,126	142,295	223,092	18,265	5,594	15,329	4,091
Delaware:	49,896	30,615	26,337	14,293	38,085	42,955	43,328	82,422	4,349	1,443	4,371	901
Kent	20,324	12,614	9,771	4,932	10,216	6,105	16,098	11,930	1,440	804	540	521
New Castle	16,783	7,934	9,313	2,944	5,704	1,384	5,085	2,639	1,573	470	2,440	272
Sussex	12,789	10,067	7,253	6,417	22,165	35,466	22,145	67,853	1,336	169	1,391	108
Maryland:	108,684	69,438	48,912	30,129	80,399	73,265	91,433	127,639	11,307	3,751	9,243	2,923
Upper Shore--	89,838	56,605	39,317	24,178	49,822	24,492	58,340	47,029	7,938	2,759	6,634	2,281
Caroline	10,725	7,500	4,741	3,855	8,075	4,291	8,980	10,533	203	416	--	275
Cecil	23,805	18,999	9,516	7,502	3,872	1,258	4,695	1,624	1,069	661	2,175	510
Kent	18,801	12,659	8,775	4,971	8,550	4,742	8,111	7,426	2,066	605	1,036	448
Queen Anne's	24,153	11,994	9,852	5,371	16,952	7,959	22,418	14,700	2,343	665	1,795	513
Talbot	12,354	5,453	6,433	2,479	12,373	6,242	14,136	12,746	2,257	421	1,628	535
Lower Shore--	18,846	12,833	9,595	5,951	30,577	48,773	33,093	80,610	3,369	992	2,609	642
Dorchester	4,352	2,580	1,567	810	2,824	9,913	4,113	13,619	793	320	429	260
Somerset	4,810	3,652	1,851	1,475	6,521	3,810	6,810	8,167	586	415	580	281
Wicomico	2,476	2,673	1,727	820	7,971	17,399	8,881	30,458	481	89	370	23
Worcester	7,208	3,928	4,450	1,371	13,261	17,651	13,289	28,366	1,509	168	1,230	78
Virginia:	4,055	2,091	1,201	924	6,171	7,906	7,534	13,031	2,609	400	1,715	267
Accomack	2,738	1,204	795	426	3,386	7,127	4,669	11,427	1,264	203	790	152
Northampton	1,317	887	406	498	2,785	779	2,865	1,604	1,345	197	925	115

1/ Including milk cows.

Continued

Table 20--Inventories and sales of livestock and poultry, Delmarva Peninsula, 1959 and 1974. (Continued)4/

Area	Milk cows Inventory 1959	Milk cows Inventory 1974	Horses and Ponies 2/ Inventory 1959	Horses and Ponies 2/ Inventory 1974	Chickens 3/ Inventory 1959	Chickens 3/ Inventory 1974	Broilers Sales (million) 1959	Broilers Sales (million) 1974	Turkeys Number Raised (thousands) 1959	Turkeys Number Raised (thousands) 1974
DELMARVA PENINSULA	72,935	36,301	7,522	5,109	1,378,021	1,691,504	155.6	286.3	507.4	323.5
Delaware	23,500	10,706	3,093	2,438	725,075	701,871	71.2	124.5	412.6	319.6
Kent	10,753	5,060	1,268	1,043	127,644	113,133	3.4	4.5	113.4	.2
New Castle	8,114	3,356	622	549	112,501	85,247	.4	--	39.8	9.3
Sussex	4,633	2,290	1,203	846	485,560	503,491	67.4	120.0	259.4	310.1
Maryland:	48,746	25,421	3,637	2,560	585,839	957,544	79.6	153.8	93.2	3.9
Upper Shore--	42,683	23,166	2,006	1,794	331,314	141,712	13.7	26.7	33.5	2.4
Caroline	5,494	2,636	447	195	86,714	88,356	10.1	20.3	8.0	1.1
Cecil	11,585	7,598	575	854	112,571	34,725	*	.1	1.4	.5
Kent	9,180	5,754	220	273	24,642	5,102	--	.1	3.6	.8
Queen Anne's	11,448	5,224	512	278	59,508	11,092	.4	1.1	1.1	--
Talbot	4,976	1,954	252	194	47,879	2,437	3.2	5.1	19.4	--
Lower Shore--	6,084	2,255	1,631	766	254,525	815,832	65.9	127.1	59.7	1.5
Dorchester	1,741	538	274	147	61,748	44,337	1.5	5.8	6.4	--
Somerset	1,182	901	144	99	65,089	160,605	14.1	26.5	.6	--
Wicomico	723	151	557	198	46,002	380,918	27.3	54.0	51.4	1.5
Worcester	2,438	655	656	322	81,686	229,972	23.0	40.8	1.3	**
Virginia:	668	174	792	111	67,107	32,089	4.8	8.0	1.6	--
Accomack	486	167	504	56	58,056	31,487	4.7	8.0	.5	--
Northampton	182	7	288	55	9,051	242	.1	--	1.1	--

2/ In 1969, the Horses and Mules category was renamed Horses and Ponies. Though the name changed, the types of livestock counted - horses, ponies, mules, burros, and donkeys - remained exactly the same.

3/ Prior to 1969 chickens were counted only if 4 months old and over. In 1969, the age was reduced to 3 months. While the change in classification may account for a small increase in the 1974 figure, 1959 and 1974 data can be considered as relatively comparable.

4/ Some data not directly comparable. 1959 definition includes 571,000 farms with less than $1,000. Though comprising 20.9% of all farms contributed less than 1% of total sales. 1974 definition includes 152,000 farms with less than 6/100 of 1% of total sales.

* Less than 50,000 broilers
** Less than 50 birds.

Source: Bureau of the Census, Census of Agriculture, 1959, 1974, 1969, and 1974.

and 1974 occurred in those counties where poultry production also showed the greatest increase.

Poultry Production. Inventory or sales of poultry - chickens, broilers, and turkeys - are illustrated in Table 20. The smallest segment of the poultry industry on the Delmarva Peninsula is turkey production which has experienced a steady decline during the past twenty years. Interestingly, while turkeys were raised to some extent in every county in 1959, by 1974 turkey production in the southern portion of the Peninsula had almost ceased entirely. Turkey production had shifted northward becoming non-existent in Virginia, relatively small in the Lower Shore subarea, moderate in the Upper Shore of Maryland, and heavily concentrated in Delaware - with 98 percent of the total. Sussex County, Delaware, raises 95 percent of the entire turkey population on the Delmarva Peninsula and was the only county to experience an increase in the number produced between 1959 and 1974.

The production of chickens (primarily laying hens and started pullets) is the next largest segment of the poultry industry. Inventories of chickens 3 months old and over rose 23 percent for the Peninsula as a whole. The Lower Shore of Maryland experienced an increase of 221 percent but inventories in the remaining three subareas declined. Chicken production is most heavily concentrated in Delaware and the Lower Shore of Maryland. Wicomico County, Maryland, experienced a phenomenal 728 percent increase in chicken production between 1959 and 1974. However, Sussex County, Delaware, still contains the heaviest concentration of chickens - raising nearly one of every three produced on the whole Peninsula.

The largest and fastest growing segment of the poultry industry on the Delmarva Peninsula is broiler production. The number of broilers sold in

1974 amounted to 286.3 million birds - an increase of 84 percent since 1959. Broiler production increased in all but two Peninsula counties. The greatest increases in absolute number occurred in Sussex County, Delaware, and in the Lower Shore of Maryland. These two areas, each with an approximately equal number of birds, together account for 4 of every 5 broilers produced on the Peninsula. Within these areas integrated broiler firms have become established as the dominant force in the industry. These firms exert complete control over the production of their broilers from the breeding flocks that produce eggs for their hatcheries to the advertising that sells their product in Boston and New York. Even after chicks are placed with contract broiler producers, the integrated firms supervise their care and feeding to ensure that death losses are minimized and weight gains maximized within established quality standards. The growth and continued viability of the poultry industry can be directly attributable to increased broiler production over the past fifteen years.

Delmarva agriculture has continued to grow despite increasing competition for land and labor on the Peninsula. Its viability, in contrast to agriculture in the Northeast in general, is the direct result of the development of those facets of its productive capacity in which it enjoys a competitive advantage. Delmarva vegetables and potatoes are harvested for fresh market to coincide with the end of the harvest season in southern states, but before harvesting begins in Pennsylvania, New Jersey, and New York. Similarly, the Delmarva broiler industry has capitalized on the Peninsula's location with respect to major urban markets and the capacity of Peninsula land to produce feed grains. To date, organizational efficiency has offset the impacts on agriculture of economic growth in the remainder of the Peninsula economy. In the future,

however, rising prices for agricultural land and increasing competition for labor will impose a constraint on further expansion of agriculture unless continued innovation is forthcoming and/or institutional arrangements are adopted to modify the impact of existing trends.

LAND USE

The Delmarva Peninsula has been relatively untouched by the trend toward urbanization occurring in other rural areas adjacent to the Boston-Washington megalopolis. Agriculture is still the major single use of land on the Peninsula and imparts a distinctively rural character to the area. In the future, however, agriculture will face increasing competition for the use of land. As the urbanizing influence of the major population centers increases, the Peninsula will become the site of more permanent and vacation homes, more industry, and more commercial areas providing goods and services to a growing population. Increasing incomes, more leisure time, early retirement and added longevity have created a demand for vacation communities and retirement homes. The demand for "second homes" occurs primarily in areas where recreational opportunities and escape from the pressures or urban living are available. The Peninsula can satisfy both requirements. The surrounding waters provide excellent boating, fishing, surfing, seaside camping, beaches, and ocean bathing. The rural character of the Peninsula provides a respite from the problems and pressures associated with urban life. The Peninsula is also easily accessible from the urban centers of Philadelphia, Wilmington, Baltimore, Washington, D.C., and Norfolk.

New industry is appearing for several reasons. First, the shift in agriculture from reliance on manpower to machinery has created a pool of unemployed and underemployed labor available for use by new industrial enterprises. Second, wage rates are comparatively less on the Delmarva Peninsula than in adjacent urban areas, resulting in lower labor costs for fledgling industrial ventures locating in the region. Third, the proximity of the

Peninsula to major markets and improvements in highway access to the Peninsula have stimulated industrial growth. And, fourth, large tracts of land are available at reasonable cost, some with publicly financed improvements designed to attract new industry.

While the trend toward more intensive land use has begun on the Peninsula, the pattern of land-use today is overwhelmingly "non-urban." Throughout the foreseeable future, extensive uses of the land resources can be expected to predominate. It must be noted, however, that development of highway frontage for residential, commercial, and industrial purposes may lead to a more urban appearance for the Peninsula than land use statistics alone would indicate.

Classification of Land Use and Data Sources

The land use areas presented in this report were estimated from maps supplied by the Delaware and Maryland State Planning Offices and the United States Geological Survey's CARETS (Central Atlantic Regional Ecological Test Sight) program. Although the degree of disaggregation in land use categories differs among the states, all follow the United States Geological Survey definition and classification scheme making aggregation to some common basis possible.

For purposes of this report, land uses were divided into three broad classifications: Urban; Agricultural; and Non-Urban, Non-Agricultural. Each broad classification is a collection of four or five specific land use categories. The following is a listing of the broad classifications, the specific land use categories, and the types of vegetation, structures, or activities which occur in each specific land use category.

I. Urban:

A. Residential Land Use. This classification includes all residential uses with no distinction being made between single-family or multi-family units. Residential units include owner-occupied townhouses, structures with two units or more, including condominiums and other forms of multi-family ownership or rental including rooming and boarding houses, membership lodges, residence halls and dormitories, retirement homes, orphanages, religious quarters, seasonal housing (such as summer cottages), and mobile home parks and courts.

B. Commercial Land Use. This classification includes those areas at which retail sales, office, and service activities are performed plus strip and cluster settlement areas.

C. Industrial Land Use. Included in this category are surface mining and extraction; warehouses; junk yards; refuse disposal; contracting construction; transportation, communications, and utilities; plus manufacturing, processing, and other light, intermediate, and heavy industry.

D. Urban Open. This classification includes educational facilities; public and private institutions; golf courses; zoos; cemeteries; urban parks; and undeveloped land within an urban setting.

II. Agricultural:

A. Cropland. Included in this classification are cropland harvested; cultivated summer-fallow and idle cropland; land on which crop failure occurs; and cropland in soil-improvement grasses and legumes.

B. Cropland/Pasture. This classification contains land which is used for pasture in rotation with crops or contains land which is

difficult to categorize as either exclusively Cropland or Pasture.

C. Pasture. Land more or less permanently used for grazing.

D. Confined Feeding Operations. Included in this category are beef cattle feedlots, dairy operations with confined feeding, poultry farms, hog feedlots, and other specialized livestock production enterprises.

E. Other Miscellaneous Agriculture. Included in this category are farmsteads; orchards; holding areas for livestock such as corrals, breeding and training facilities on horse farms; farm lanes and roads; ditches, and similar related uses.

III. Non-Urban, Non-Agricultural:

A. Woodlands. This category contains all commercial and non-commercial forests; land used for forestry activities and related service; and wooded areas within the confines of farms.

B. Inland Water. Included in this classification are natural and artificial impoundments of water - ponds, lakes, or reservoirs - used for irrigation, flood control, municipal water supplies, recreation, or electric power generation.

C. Wetlands. Included in this category are areas where the water level is at, near, or above the land surface for a significant portion of the year, such as mudflats, marshes, swamps, bogs, and potholes.

D. Beach, Transitional, and Barren Land. This category consists of beaches - smooth sloping accumulations of sand, pebbles, and gravel along a shoreline; non-beach sand accumulations; transitional areas

in which an indeterminate change in land use is occurring - forest land cleared, wetlands drained, or acreage bared; strip mines, quarries, and gravel pits; and barren land - bare exposed rock or accumulations of rock without vegetative cover.

Peninsula Land Use

Land use acreages for the 14 counties in the survey area are shown in Table 21. Only acreages south of the Chesapeake and Delaware Canal are included for Cecil County, Maryland, and New Castle County, Delaware. Based upon acreage data, Table 22 presents land uses as a percentage of total land area. The proportion of total acreage devoted to each land use is shown by county.

Of the three broad classifications, the percentage of land in Urban use is the smallest. Only 3.5 percent of the entire Peninsula land area is devoted to urban activities. Of all land usage on the Peninsula, 42.7 percent is agricultural in nature. The largest proportion of land area is in the Non-Urban, Non-Agricultural classification. Over half (53.8%) of the land acreage on the Delmarva Peninsula is employed in uses other than urban or agricultural with Woodland (36.7%) and Wetland (15.9%) accounting for the bulk (52.6%) of this acreage.

Within the Urban classification the predominant land use is Residential. The pattern and character of Residential land use varies considerably within the Peninsula. Sussex County, Delaware, accounting for over one-sixth the total land area of the Peninsula, has the largest amount of acreage devoted to Residential use. Of all land in Sussex County, 17,500 acres or 2.9 percent is residential in nature. Kent County, Delaware, has the second greatest

Table 21--Land use acreage, Delmarva Peninsula, 1970[1/]

Area	Urban					Agricultural			
	Residential	Commercial	Industrial	Urban Open	Total Urban	Cropland[3/]	Cropland Pasture	Pasture	Confined Feeding
DELMARVA PENINSULA	79,098	14,800	16,514	26,295	136,709	1,347,602	163,158	32,731	24,409
Delaware:	29,163	3,405	9,448	11,495	53,511	520,887	435	23,863	3,406
Kent	9,723	1,433	3,199	5,732	20,087	195,440	0	6,295	179
New Castle[2/]	1,690	230	563	461	2,944	64,538	0	4,864	51
Sussex	17,750	1,742	5,686	5,302	30,479	260,892	435	12,704	3,176
Maryland:	47,143	7,541	5,936	12,847	73,469	826,715	9,302	8,868	21,003
Upper Shore	21,944	2,750	2,611	6,289	33,595	498,740	8,035	7,936	4,062
Caroline	2,653	918	51	765	4,388	102,247	7,296	2,373	2,475
Cecil[2/]	1,818	77	128	1,229	3,251	39,552	230	2,842	0
Kent	4,173	489	515	824	6,002	113,728	0	1,443	0
Queen Anne's	6,247	326	1,003	1,982	9,558	141,761	326	677	803
Talbot	7,053	940	914	1,489	10,396	101,452	183	601	784
Lower Shore	25,199	4,791	3,325	6,558	39,874	327,975	1,267	932	16,941
Dorchester	5,407	769	1,007	1,087	8,270	112,440	186	106	1,325
Somerset	3,375	482	203	888	4,949	48,546	279	178	3,857
Wicomico	7,814	1,845	1,255	1,793	12,707	79,444	359	205	5,841
Worcester	8,603	1,695	860	2,790	13,948	87,545	443	443	5,918
Virginia:	2,792	3,854	1,130	1,953	9,729	N.A.	153,421	N.A.	N.A.
Accomack	2,137	2,292	1,004	1,802	7,235	N.A.	97,666	N.A.	N.A.
Northampton	655	1,562	126	151	2,494	N.A.	55,755	N.A.	N.A.

N.A. signifies not available.

1/ Due to the employment of various mathematical techniques, aggregate totals not always equal to the sum of subtotals.

2/ In New Castle County (Delaware) and Cecil County (Maryland) data only for acreage south of the Chesapeake and Delaware Canal.

Continued

Table 21--Land use acreage, Delmarva Peninsula, 1970

Area	Agricultural: Other Misc. Agriculture	Total Agriculture	Non-urban, non-agricultural: Woodland	Inland Water	Wetland	Beach/ Trans/ Barren	Total Non-Urban, Non-Agric.	Final Total
DELMARVA PENINSULA	9,324	1,577,225	1,382,828	18,062	436,506	13,708	1,851,085	3,565,025
Delaware:	7,757	556,348	399,652	7,245	85,362	4,072	496,314	1,106,175
Kent	2,968	204,882	110,690	2,508	42,246	384	155,827	380,800
New Castle	1,715	71,168	29,977	896	14,592	358	45,824	119,935
Sussex	3,074	280,281	258,985	3,842	28,507	3,330	294,664	605,440
Maryland:	1,464	867,353	838,798	10,049	220,923	2,816	1,072,584	2,013,410
Upper Shore--	925	519,698	303,482	3,256	17,384	0	324,122	877,414
Caroline	51	114,441	84,082	306	1,582	0	85,970	204,800
Cecil	0	42,624	25,805	589	1,306	0	27,698	73,574
Kent	773	115,944	52,756	902	6,157	0	59,814	181,760
Queen Anne's	75	143,643	79,873	728	4,917	0	85,518	238,720
Talbot	26	103,045	60,966	731	3,422	0	65,119	178,560
Lower Shore--	539	347,655	535,316	6,793	203,539	2,816	748,462	1,136,000
Dorchester	0	114,057	152,781	4,374	91,714	0	248,868	371,200
Somerset	51	52,911	90,315	736	63,569	0	154,620	212,480
Wicomico	410	86,259	127,195	640	16,371	26	144,232	243,200
Worcester	78	94,428	165,025	1,043	31,885	2,790	200,742	309,120
Virginia:	103	153,524	144,378	768	130,221	6,820	282,187	445,440
Accomack	103	97,769	105,957	541	84,972	4,326	195,796	300,800
Northampton	0	55,755	38,421	227	45,249	2,494	86,391	144,640

3/ The Virginia state classification system includes all cropland and pasture acreage in one category - cropland/pasture; acreage not divided into separate cropland and pasture components.

Source: Developed from land use maps obtained from the Delaware and Maryland State Planning Offices (1970); The U.S. Geological Survey C.A.R.E.T.S.(Central Atlantic Regional Ecological Test Sight) Program (1970) for Virginia; and the 1964 U.S. Census of Agriculture as a reference for land acreage bases. Tables 21-23 generated by John Wenderoth - Land Use Planner - U.S.D.A., E.S.C.S., Broomall, PA.

Table 22--Land use as a percent of total land area, Delmarva Peninsula, 1970

Area	Urban					Agricultural			
	Residential	Commercial	Industrial	Urban Open	Total Urban	Cropland	Cropland Pasture	Pasture	Confined Feeding
	Percent								
OELMARVA PENINSULA	1.8	.5	.5	.7	3.5	29.4	11.7	.9	.4
Oelaware:	2.6	.3	.9	1.0	4.8	47.1	.0	2.2	.3
Kent	2.6	.4	.8	1.5	5.3	51.3	.0	1.7	.0
New Castle	1.4	.2	.5	.4	2.5	53.8	.0	4.1	.0
Sussex	2.9	.3	.9	.9	5.0	43.1	.1	2.1	.5
Maryland:	2.3	.4	.3	.6	3.7	41.2	.5	.4	1.0
Upper Shore--	2.5	.3	.3	.7	3.8	56.8	.9	.9	.5
Caroline	1.3	.4	.0	.4	2.1	49.9	3.6	1.2	1.2
Cecil	2.5	.1	.2	1.7	4.4	53.8	.3	3.9	.0
Kent	2.3	.3	.3	.5	3.3	62.6	.0	.8	.0
Queen Anne's	2.6	.1	.4	.8	4.0	59.4	.1	.3	.3
Talbot	3.9	.5	.5	.8	5.8	56.8	.1	.3	.4
Lower Shore--	2.2	.4	.3	.6	3.5	28.8	.1	.1	1.5
Dorchester	1.5	.2	.3	.3	2.2	30.3	.0	.0	.4
Somerset	1.6	.2	.1	.4	2.3	22.8	.1	.1	1.8
Wicomico	3.2	.8	.5	.7	5.2	32.7	.1	.1	2.4
Worcester	2.8	.5	.3	.9	4.5	28.3	.1	.1	1.9
Virginia:	.6	.9	.3	.4	2.2	N.A.	34.5 1/	N.A.	N.A.
Accomack	.7	.8	.3	.6	2.4	N.A.	32.5	N.A.	N.A.
Northampton	.5	1.1	.1	.1	1.8	N.A.	38.5	N.A.	N.A.

N.A. signifies not available.
1/ This may be considered to be primarily cropland since there is relatively little pastureland on this part of the peninsula.
Source: Calculated from data presented in Table 21.

Table 22--Land use as a percent of total land area, Delmarva Peninsula, 1970

Area	Agricultural: Other Misc. Agriculture	Total Agriculture	Non urban, non-agricultural: Woodland	Inland Water	Wetland	Beach/ Trans/ Barren	Total Non-Urban, Non-Agricultural	Final Total
	Percent							
DELMARVA PENINSULA	.3	42.7	36.7	.5	15.9	.7	53.8	100.0
Delaware:	.7	50.3	36.1	.7	7.7	.4	44.9	100.0
Kent	.8	53.8	29.1	.7	11.1	.1	40.9	100.0
New Castle	1.4	59.3	25.0	.7	12.2	.3	38.2	100.0
Sussex	.5	46.3	42.8	.6	4.7	.5	48.7	100.0
Maryland:	.1	43.2	41.6	.5	10.9	.1	53.1	100.0
Upper Shore--	.1	59.2	34.6	.4	2.0	.0	37.0	100.0
Caroline	.0	55.9	41.1	.1	.8	.0	42.0	100.0
Cecil	.0	57.9	35.1	.8	1.8	.0	37.7	100.0
Kent	.4	63.8	29.0	.5	3.4	.0	32.9	100.0
Queen Anne's	.0	60.1	33.5	.3	2.1	.0	35.9	100.0
Talbot	.0	57.7	34.1	.4	1.9	.0	36.5	100.0
Lower Shore--	.0	30.6	47.2	.6	17.9	.2	65.9	100.0
Dorchester	.0	30.7	41.2	1.2	24.7	.0	67.1	100.0
Somerset	.0	24.9	42.5	.3	29.9	.0	72.8	100.0
Wicomico	.2	35.5	52.3	.3	6.7	.0	59.3	100.0
Worcester	.1	30.6	53.4	.3	10.3	.9	64.9	100.0
Virginia:	.0	34.5	32.4	.2	29.2	1.5	63.3	100.0
Accomack	.0	32.5	35.2	.2	28.2	1.4	65.1	100.0
Northampton	.0	38.5	26.6	.2	31.3	1.7	59.7	100.0

Source: Calculated from data presented in Table 21.

concentration of Residential land use with 9,723 acres. Other significant concentrations of Residential land acreage are found in Worcester County, Wicomico County, and Talbot County, Maryland.

The average amount of land in Commercial use on the Delmarva Peninsula is relatively small - one half of one percent. However, among the 14 counties the percentage of Commercial land use ranges from .1 to 1.1 percent. Within the region two of the most active centers of commerce are Dover, Delaware, and Salisbury, Maryland. Dover serves as a major center for wholesale and retail trade in the northern portion of the Peninsula. Salisbury - regional center for wholesaling, retailing, transportation, and services - performs the same function for the southern Peninsula. While commercial activity is generally located in areas with high population concentrations, there are some interesting exceptions. In Virginia the percentage of land devoted to Commercial activities is greater than that of Residential use in both Northampton (1.1%) and Accomack (.8%) counties. This may be attributable, in part, to the expansion of commercial enterprises to accommodate non-residents--such as tourists, hunters, and truckers--who may account for a significant portion of trade in an area in which the resident population base is relatively low. In addition, land uses connected with water related activities such as docks, marina complexes, and seafood processing facilities were categorized as Commercial in an area in which coastal areas, inlets, and harbors abound.

Within the 14 counties on the Delmarva Peninsula the amount of land used for Industrial purposes ranges from approximately 50 to 5,680 acres. As a general rule, industrialization is greatest in those counties with the largest amounts of Residential and Commercial activity. Such areas of

large population concentrations usually possess the diverse transportation network necessary for efficient access to markets; skilled labor, and supporting suppliers of equipment and industrial services. However, relatively large acreages of industrial use also appear in some Peninsula counties where forests and farms supply sources of raw material - such as timber, broilers, and vegetables - for processing.

Approximately 26,300 acres of land on the Delmarva Peninsula are devoted to Urban Open uses--11,495 acres in Delaware, 12,847 acres in Maryland, and 1,953 acres in Virginia. While Kent County, Delaware, has the largest amount of acreage (5,732 acres), Cecil County, Maryland, has the greatest proportion (1.7%) of land in Urban Open use. Northampton County, Virginia, has the least amount--both in terms of acreage and proportion--of Urban Open land on the Peninsula.

Of the three general classifications, Agricultural activity occurs on over four of every ten acres of land on the Delmarva Peninsula. Although rather evenly distributed, the northern counties have a considerably larger portion of total land area devoted to agriculture than the counties in the southern half of the Peninsula. In the Upper Shore area of Maryland, for example, Agricultural land use is 59.2 percent of the total land area while in the Lower Shore area only 30.6 percent of total land area is agricultural. In part, this is a reflection of the larger proportion of total land suitable for agriculture in the Upper Shore area since wetlands account for over a sixth of the land area (17.9%) in the Lower Shore area as compared to only 2.0 percent in the Upper Shore. In every county, however, Agricultural land use is more than 24 percent of total land area.

Within the Agricultural classification, Cropland is the largest land use - with 29.4 percent of the Peninsula total. Three counties in the Upper Shore area contain the greatest percentage of Cropland: Kent (62.4%), Queen Anne's (59.4%), and Talbot (56.8%). In every county in Delaware and Maryland Cropland comprises more than one-fifth (22%) of land use.

In Delaware and Maryland, land uses which could neither be clearly identified as either Cropland or Pasture or which served both purposes were placed in a special Cropland/Pasture category. Due to a definitional difference, all acreage, whether Cropland or Pasture, was categorized as Cropland/Pasture in Virginia. However, the actual ratio of Cropland to Pasture in Virginia is probably very similar to that of the southern counties of Maryland.

Pasture accounted for .9 percent of land usage. Acreage devoted to pasture was relatively greater in Delaware and the Upper Shore of Maryland than in the rest of the Peninsula. Cecil County, Maryland, with 3.9 percent had the highest proportion of land in pasture. Separate Pasture land area was not estimated for Virginia but can safely be considered as a relatively small proportion.

As Table 22 illustrates, the second smallest category within the Agricultural classification is Confined Feeding. A significant portion of land in the Confined Feeding category is used for poultry production. The largest percentage of Confined Feeding occurs in the Lower Shore area of Maryland, where the broiler industry is very heavily concentrated. The counties of Wicomico, Worcester, and Somerset, Maryland, account for the greatest acreages of Confined Feeding. In Delaware, the percentage of land devoted to Confined Feeding is relatively low while in Virginia the proportion, because of the lack of a separate classification, cannot be

reliably estimated.

All land neither Urban nor Agricultural is included in the Non-Urban, Non-Agricultural classification. Two of the larger categories, Woodland and Wetland, might well be considered as separate classifications under another grouping system. Over 1.3 million acres can be categorized as Woodland on the Delmarva Peninsula. Only Total Agriculture with approximately 1.5 million acres is a larger land use than Woodland. The amount of acreage contained in the Wetland category is three times as great as that in the Total Urban classification. In comparison to Total Agriculture, however, Wetland land use accounts for only one-third as much area. The two other categories within the Non-Urban, Non-Agricultural classification, Inland Water and Beach/Transitional/Barren, are relatively minor uses which combined account for less than 1.5 percent of total Peninsula land acreage.

In comparison to the other two general classifications, acreage devoted to Non-Urban, Non-Agricultural purposes is 15.37 times as great as Urban and 1.26 times as great as Agricultural land use. The Non-Urban, Non-Agricultural classification accounts for over half (53.8%) of total Peninsula usage. The largest concentration of Non-Urban, Non-Agricultural land occurs in the Lower Shore area of Maryland and in Virginia. The amount of Non-Urban, Non-Agricultural land ranges from 32.9 percent in Kent County, Maryland, to 72.8 percent in Somerset County, Maryland.

Woodland is the largest category within the Non-Urban, Non-Agricultural classification and accounts for over one-third (36.7%) of Peninsula land area. Like Agricultural land, Woodland is relatively evenly distributed on the Peninsula with each county having at least one quarter of total land area in Woodland uses. In contrast to the distribution of Agricultural

land, however, the counties in the southern half of the Peninsula have a larger percentage of Woodland than those in the northern part. Woodland in the Lower Shore counties of Worcester and Wicomico, Maryland, accounts for 53.4 percent and 52.3 percent of land area, respectively. Commercial forestry or the Delmarva Peninsula is most heavily concentrated in the Lower Shore of Maryland where the greatest amount of forest and woodland is located.

Wetland, the second largest category within the Non-Urban, Non-Agricultural classification, accounts for 15.9 percent of Peninsula land area. In terms of distribution, the lower half of the Peninsula has considerably larger acreages of Wetland than the northern sector. While relatively sparse in the Upper Shore area of Maryland, Wetland accounts for over one-fifth of total land acreage in several counties on the Lower Shore of Maryland and Virginia. In Northampton County, Virginia, Somerset County, Maryland, and Accomack County, Virginia, Wetland ranges between 28 and 31 percent of total land area.

Table 23 presents the county land use data as a percent of the Delmarva total and further illustrates the distribution of land use among counties. Data in Table 23 substantiates the fact that land use below the Chesapeake and Delaware Canal is overwhelmingly rural in nature with small urban areas accounting for the residential, commercial, and industrial activity.

Table 23--Land and water areas and land use as a percent of survey area totals, Delmarva Peninsula, 1970.

Area	Urban					Agricultural			
	Residential	Commercial	Industrial	Urban Open	Total Urban	Cropland	Cropland/ Pasture	Pasture	Confined Feeding
	Percent								
DELMARVA PENINSULA	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Delaware:	37.0	23.1	57.4	43.9	39.3	38.8	.3	72.9	14.0
Kent	12.4	9.7	19.4	21.9	14.8	14.6	.0	19.2	.7
New Castle	2.1	1.6	3.4	1.8	2.2	4.8	.0	14.9	.2
Sussex	22.5	11.8	34.5	20.2	22.4	19.4	.3	38.8	13.1
Maryland:	59.5	50.7	35.8	48.7	53.6	61.2	5.7	27.1	86.0
Upper Shore--	27.9	18.6	15.9	24.0	24.6	37.2	4.9	24.3	16.8
Caroline	3.4	6.3	.3	2.9	3.2	7.6	4.5	7.3	10.2
Cecil	2.3	.5	.8	4.7	2.4	2.9	.1	8.7	.0
Kent	5.3	3.3	3.1	3.1	4.4	8.4	.0	4.4	.0
Queen Anne's	8.1	2.3	6.2	7.7	7.2	10.8	.2	2.1	3.4
Talbot	8.8	6.2	5.4	5.6	7.5	7.4	.1	1.8	3.2
Lower Shore--	31.6	32.1	19.9	24.7	28.9	24.0	.8	2.8	69.2
Oorchester	6.6	5.0	5.9	4.0	5.9	8.1	.1	.3	5.3
Somerset	4.3	3.3	1.2	3.4	3.7	3.6	.2	.5	16.0
Wicomico	9.9	12.5	7.6	6.8	9.3	5.9	.2	.6	24.0
Worcester	10.7	11.3	5.1	10.4	10.1	6.4	.3	1.3	23.9
Virginia:	3.5	26.2	6.9	7.4	7.1	N.A.	94.0	N.A.	N.A.
Accomack	2.7	15.5	6.1	6.8	5.3	N.A.	59.4	N.A.	N.A.
Northampton	.8	10.8	.8	.6	1.9	N.A.	34.6	N.A.	N.A.

N.A. signifies Not Available.

Source: Calculated from data presented in Table 21.

Table 23--Land and water areas and land use as a percent of survey area totals, Delmarva Peninsula, 1970.

Area	Agricultural: Other Misc. Agriculture	Agricultural: Total Agriculture	Non urban, non-agricultural: Woodland	Non urban, non-agricultural: Inland Water	Non urban, non-agricultural: Wetland	Non urban, non-agricultural: Beach/ Trans/ Barren	Total Non-Urban, Non-Agric.	Final Total
	Percent							
DELMARVA PENINSULA	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Delaware:	83.3	35.3	29.1	40.5	19.7	29.8	27.0	31.1
Kent	31.9	13.0	8.1	14.0	9.7	2.8	8.5	10.7
New Castle	18.4	4.5	2.2	5.0	3.4	2.6	2.5	3.4
Sussex	33.0	17.8	18.8	21.5	6.6	24.3	16.0	17.0
Maryland:	15.7	54.9	60.4	55.2	50.2	20.2	57.7	56.3
Upper Shore--	9.8	33.1	22.0	18.2	4.0	.0	17.6	24.7
Caroline	.5	7.3	6.1	1.7	.4	.0	4.7	5.8
Cecil	.0	2.7	1.9	3.3	.3	.0	1.5	2.1
Kent	8.2	7.3	3.8	5.0	1.4	.0	3.2	5.1
Queen Anne's	.8	9.3	5.9	4.1	1.2	.0	4.7	6.9
Talbot	.3	6.4	4.3	4.0	.8	.0	3.5	4.9
Lower Shore--	5.8	21.8	38.4	37.1	46.2	20.2	40.1	31.5
Dorchester	.0	7.0	10.7	23.6	20.4	.0	13.1	10.1
Somerset	.5	3.4	6.6	4.1	14.8	.0	8.5	6.0
Wicomico	4.4	5.5	9.2	3.6	3.8	.2	7.8	6.8
Worcester	.8	5.9	11.8	5.7	7.2	20.0	10.7	8.6
Virginia:	1.1	9.8	10.5	4.3	30.1	50.0	15.3	12.6
Accomack	1.1	6.2	7.7	3.0	19.5	31.5	10.6	8.4
Northampton	.0	3.6	2.8	1.3	10.6	18.5	4.8	4.1

Source: Calculated from data presented in Table 21.

WATER USE

Water is a major resource in both manufacturing and agriculture. The "use" of water in the two sectors, however, has different implications for water supply and water quality. Most manufacturing water use is for cleaning and cooling with very little of the water intake being embodied in the product or lost to the atmosphere as evaporation or transpiration. Thus, the supply of water to other users is substantially unchanged by its use in manufacturing. Water quality, on the other hand, is often adversely affected by the waste heat, organic materials, heavy metals, and nutrients in manufacturing waste water. Agricultural water use is consumptive to the extent that it is used for irrigation; livestock and poultry consumption; and domestic purposes. Compared to manufacturing use of water, agricultural use may have a greater impact on water supply particularly when large acreages are irrigated. Agricultural use also has impacts on water quality. Poor farming techniques can result in runoff with high sediment loads and in the discharge of fertilizer nutrients and pesticides into waterways. Runoff from feedlots may also contribute high concentrations of animal waste. The goal in water resources management for both uses, however, is the same - to maximize productive use of available supplies and to minimize pollution of all types.

Manufacturing

The major water-using industries on the Peninsula are those engaged in the manufacture of food and kindred products; textile mill products; lumber and wood products; chemicals; rubber products; stone, clay, glass and concrete products; primary metals; and machinery except electrical machinery. In 1973 there were 149 establishments on the Delmarva Peninsula in these industry

groups. Of the total, 104 (70%) were in the food and kindred products group. Table 24 lists the number of establishments by industry group and by county.

Caroline, Dorchester, Talbot, and Wicomico Counties in Maryland and Sussex County, Delaware, each had ten or more establishments engaged in manufacturing and processing food and kindred products. These counties also accounted for a major proportion of the vegetables grown on the Peninsula, broilers raised, and seafood landed. Among the other industry groups, only chemicals and allied products and stone, clay, glass, and concrete products had three or more establishments in any one county. Eight plants in the chemical group were located in Sussex County, Delaware. The counties of Kent and Sussex in Delaware and Wicomico in Maryland each had three establishments engaged in stone, clay, glass, or concrete product manufacturing.

Agriculture

Agricultural water use for the Chesapeake Bay Study Area, which includes the Delmarva Peninsula, was estimated for the years 1950, 1960, and 1970.[1/] This section summarizes the procedure used to develop those estimates and presents the estimates of the three components of rural water use - rural domestic; livestock and poultry; and irrigation - for the 14 counties on the Peninsula.

Rural Domestic Water Use. Between 1950 and 1970 the domestic population was a major user of water in rural areas. By 1970 Census of Population definition, the rural domestic population is composed of a rural farm component and a rural nonfarm component. All rural residents living on farms were classified as rural farm, while the remaining rural population was categorized as rural nonfarm.

1/ John Green, Rural Water Uses, 1950-1960-1970, Chesapeake Bay Study Area, NRED, ERS, USDA, Upper Darby, PA, April 1973.

Table 24--Number of establishments in major water-using industries, Delmarva Peninsula, 1973[1/]

Industry	Delaware		Total	Maryland				Upper Shore-	Maryland
	Kent	Sussex	Delaware	Caroline	Kent	Queen Anne	Talbot	Maryland	Dorches
Food and Kindred Products	4	10	14	13	6	4	10	33	23
Textile Mill Products	1	1	2	-	-	-	1	1	-
Lumber and Wood Products	-	-	-	-	1	1	-	2	1
Chemicals and Allied Products	3	8	11	-	1	-	1	2	1
Rubber Products	-	3	3	1	-	-	2	3	-
Stone, Clay, Glass and Concrete Products	1	1	2	2	1	1	2	6	-
Primary Metal Industries	-	-	-	-	-	-	-	-	1
Machinery except Electrical	-	1	1	-	1	-	1	2	-
Totals	9	24	33	16	10	6	15	47	26
Percent	6%	16%	22%	11%	7%	4%	10%	32%	17%

Continued

1/ Exclusive of New Castle County, Delaware, and Cecil County, Maryland.

Table 24--Number of establishments in major water-using industries, Delmarva Peninsula, 1973 (Continued)

	Maryland			Lower Shore-	Total	Virginia		Total	Delmarva
	Somerset	Wicomico	Worcester	Maryland	Maryland	Accomack	Northampton	Virginia	Peninsula
Food and Kindred Products	6	14	5	48	81	6	3	9	104
Textile Mill Products	1	--	-	1	2	-	-	-	4
Lumber and Wood Products	-	--	-	1	3	-	-	-	3
Chemicals and Allied Products	-	--	-	1	3	1	-	1	15
Rubber Products	-	--	-	-	3	-	-	-	6
Stone, Clay, Glass and Concrete Products	-	3	1	4	10	1	-	1	13
Primary Metal Industries	-	-	-	1	1	-	-	-	1
Machinery except Electrical	-	-	-	-	2	-	-	-	3
Totals	7	19	6	58	105	8	3	11	149
Percent	5%	13%	4%	39%	71%	5%	2%	7%	100%

Source: Chesapeake Bay - Existing Conditions Report, Appendix B, Department of the Army, Baltimore District Corps of Engineers, 1973.

In 1950 the rural population on the Peninsula was 332,299 and by 1970 had increased slightly more than 20 percent to 400,319 (Table 1). The rural nonfarm population comprised 70.4 percent of the rural population in 1950, 84.5 percent in 1960, and 92.2 percent in 1970. During this period the official rural nonfarm population count increased in the Northeast due to two major factors: (1) the increased development of rural areas, and (2) changed Census definitions that narrowed the "rural farm" classification.[1/]

Given the rural farm and nonfarm populations, the proportion of the rural population served by running water in each county for 1950, 1960, and 1970 was obtained by computing the percentages of rural farm and nonfarm households served by running water as reported in 1950, 1960, and 1970 Censuses of Housing; multiplying rural farm and nonfarm populations by these percentages, adding the resulting two figures; and dividing by the total rural population. This method assumed that the average size rural farm and nonfarm household, with and without running water, were the same.

Annual water use rates for households with and without running water were obtained from published information of the United States Geological Survey (USGS). The total amount of water used by the rural population annually was then obtained by multiplying rural population numbers with and without running water by the appropriate annual use rates. Rural domestic water used by county for 1950, 1960, and 1970 is shown in Table 25. Total rural domestic water use on the Peninsula rose from 3,215.2 million gallons annually in 1950 to 6,377.0 million gallons annually in 1970, an increase of 98.3 percent. The differences among counties for each year reflected differences in rural population by county and the proportion of county residences with and without running water in the stated years.

1/ Chesapeake Bay, Existing Conditions Report, Appendix B - The Land - Resources and Use., p. BX-7, BX-10.

Table 25--Annual rural domestic water use, Delmarva Peninsula, 1950, 1960, and 1970.

Area	1950	1960	1970	Percent Change 1950-1970
	Million Gallons			
DELMARVA PENINSULA	3215.2	5283.8	6377.0	98.3
Delaware:	1353.8	2278.8	2846.3	110.2
Kent	277.3	790.0	1001.9	261.3
New Castle	558.7	660.0	697.5	24.8
Sussex	517.8	828.8	1146.9	121.5
Maryland:	1494.1	2503.1	3002.6	101.0
Upper Shore--	828.2	1441.9	1676.8	102.5
Caroline	166.6	251.4	303.3	82.1
Cecil	294.9	619.4	652.6	121.3
Kent	94.9	158.2	187.0	97.0
Queen Annes	125.5	204.9	271.8	116.6
Talbot	146.3	208.0	262.1	79.2
Lower Shore--	665.9	1061.2	1325.8	99.1
Dorchester	129.1	189.4	247.3	91.6
Somerset	116.6	163.0	206.7	77.3
Wicomico	218.9	443.8	618.7	182.6
Worcester	201.3	265.0	253.1	25.7
Virginia	367.3	501.9	528.1	43.8
Accomack	224.3	331.3	359.1	60.1
Northampton	143.0	170.6	169.0	18.2

Source: Rural Water Uses, 1950-1960-1970, Chesapeake Bay Study Area, NRED-ERS-USDA, Upper Darby, Pa., April 1973.

Livestock and Poultry Water Use. Another component of agricultural water use is water used by livestock and poultry. Water is required to sustain these animals and to enable them to produce the livestock and poultry products marketed by Peninsula farmers.

At five year intervals the United States Department of Commerce conducts a Census of Agriculture to obtain data on the number of livestock and poultry raised and marketed during the previous year. In order to correspond as closely as possible to the Census of Population years used to determine rural domestic water use, the Censuses of Agriculture for the years 1959, 1969, and 1974 were used as data sources for livestock and poultry numbers. Inventory numbers from the Census of Agriculture were used as the measure of cattle and calves; milk cows; sheep and lambs; horses and ponies; and chickens three months and older. Since hogs and pigs; broilers; and turkeys have production cycles of less than one year, the inventory numbers did not accurately reflect the number of these species actually raised over the course of a year. Consequently, number sold alive was used as the measure of annual production of hogs and pigs; broilers; and turkeys.

Production trends for livestock and poultry for the period 1959-1974 are shown in Table 20 for the fifteen years between 1959 and 1974. Inventories of cattle and calves; milk cows; sheep and lambs; and horses and ponies all decreased substantially after 1959 while the inventory of chickens three months and older increased over 22 percent. Sales of hogs and pigs rose 56 percent over the fifteen-year period. Between 1959 and 1974, sales of broilers increased dramatically. In 1959, 155.6 million broilers were sold. By 1974, this number had risen to 286.3 million birds, an 84 percent increase.

Production and sale of turkeys, on the other hand, declined substantially over the same period.

Water use rates for each type of livestock or poultry were obtained from USGS and applied to the inventory or sales numbers as appropriate. The water use rates represented on-farm water use only. Water used in the processing of livestock and poultry products was not included.[1/] Annual water use estimates for livestock and poultry by county for 1959, 1969, and 1974 are shown in Table 26. Total livestock and poultry water use rose from 1,863.9 million gallons in 1959 to 2,161.6 million gallons in 1974, an increase of 16.0 percent. Differences in livestock and poultry water use among the counties over the three census years are a reflection of changes both in the numbers of livestock and poultry raised in each county and in the water use coefficients for each species. In general, those counties with relatively large populations of chickens and broilers in 1974 (see Table 20) showed the largest increase in livestock and poultry water use over the period. Those counties with large proportions of cattle; milk cows; and sheep and lambs, on the other hand, generally experienced an absolute decrease in water use during the same period. Table 27 further illustrates county trends in livestock and poultry water use by species for the period 1959-1974. For the Peninsula as a whole, only cattle and calves; hogs and pigs; chickens three months and older; and broilers used substantially more water in 1974 than in 1959. Water used by milk cows decreased substantially because of a drastic reduction in the number of milk cows (Table 20). This occurred despite an increase in per capita water use by milk cows between 1959 and 1974.

1/ Chesapeake Bay, Existing Conditions Report, Appendix B - The Land - Resources and Use., p. BX-20.

Table 26--Annual water use by livestock and poultry, Delmarva Peninsula, 1959, 1969, and 1974.

Area	1959	1969	1974	Percent Change 1/ 1959-1974
	- - - - - - - -	Million Gallons	- - - - - - - -	
DELMARVA PENINSULA	1,863.9	2,201.1	2,161.6	16.0
Delaware	621.0	761.5	796.1	28.2
Kent	185.2	162.9	157.6	-14.9
New Castle	118.7	94.2	86.0	-27.6
Sussex	317.1	504.4	552.5	74.2
Maryland:	1,194.0	1,370.0	1,309.7	09.7
Upper Shore--	828.8	776.1	704.3	-15.0
Caroline	133.0	158.0	145.8	09.6
Cecil	202.1	184.9	187.4	-07.3
Kent	160.3	154.1	141.5	-11.7
Queen Anne's	212.3	172.0	145.7	-31.4
Talbot	121.1	107.1	83.9	-30.1
Lower Shore--	365.2	593.9	605.4	65.8
Dorchester	42.1	58.4	57.2	35.9
Somerset	77.5	127.6	123.1	58.9
Wicomico	111.1	224.1	229.3	106.4
Worcester	134.5	183.8	195.8	45.6
Virginia:	48.9	69.6	55.8	14.1
Accomack	35.7	54.6	49.2	37.8
Northampton	13.2	15.0	6.6	-50.0

1/ Percent change obtained by subtracting 1959 from 1974 figure and dividing the difference by the 1959 figure.

Source: Rural water Uses, 1950-1960-1970, Chesapeake Bay Study Area, NRED-ERS,USDA, Upper Darby, Pa., April 1973, and Bureau of Census, Census of Agriculture, 1959, 1969, and 1974

Table 27--Annual livestock and poultry water use by species, Delmarva Peninsula, 1959, 1969, and 1974.

Area	Cattle and Calves 1959	1969	1974	Milk Cows 1959	1969	1974	Hogs and Pigs 1959	1969	1974	Sheep and Lambs 1959	1969	1974
	-Million Gallons-											
DELMARVA PENINSULA	367.9	441.4	447.4	754.6	512.2	463.7	207.7	353.7	325.7	13.3	7.7	4.1
Delaware	99.9	120.0	134.1	214.4	152.8	136.8	63.2	118.7	120.3	3.2	1.5	1.1
Kent	44.6	53.5	55.2	98.1	71.3	64.6	23.5	22.4	17.4	1.1	0.7	0.6
New Castle	30.6	36.8	34.8	74.0	45.5	42.9	7.4	5.3	3.9	1.1	0.5	0.3
Sussex	24.7	29.7	44.1	42.3	36.0	29.3	32.3	91.0	99.1	1.0	0.3	0.1
Maryland:	256.4	307.6	304.1	534.1	355.1	324.7	133.5	215.1	186.4	8.2	5.6	2.7
Upper Shore--	216.8	260.1	247.9	467.5	321.2	296.0	85.1	93.2	68.7	5.7	4.7	2.0
Caroline	26.3	31.5	32.9	60.2	44.4	33.7	13.1	15.1	15.4	0.1	0.1	0.3
Cecil	63.7	76.5	83.2	126.9	96.8	97.1	6.9	4.3	2.4	0.8	1.6	0.5
Kent	45.3	54.3	55.4	100.5	78.6	73.5	11.8	18.2	10.8	1.5	1.5	0.4
Queen Anne's	48.5	58.2	52.5	125.4	74.8	66.7	32.7	32.0	21.5	1.7	0.9	0.5
Talbot	33.0	39.6	23.9	54.5	26.6	25.0	20.6	23.6	18.6	1.6	0.6	0.3
Lower Shore--	39.6	47.5	56.2	66.6	33.9	28.7	48.4	121.9	117.7	2.5	0.9	0.7
Dorchester	9.9	11.9	11.3	19.1	12.4	6.9	6.0	16.6	19.9	0.6	0.3	0.2
Somerset	10.5	12.6	16.0	12.9	10.1	11.5	9.9	14.7	11.9	0.4	0.3	0.3
Wicomico	4.5	5.4	11.7	7.9	2.8	1.9	13.1	51.3	44.5	0.4	0.1	0.1
Worcester	14.7	17.6	17.2	26.7	8.6	8.4	19.4	39.3	41.4	1.1	0.2	0.1
Virginia:	11.6	13.8	9.2	6.1	4.3	2.2	11.0	19.9	19.0	1.9	0.6	0.3
Accomack	6.8	8.1	5.3	4.4	2.1	2.1	6.8	13.4	16.7	0.9	0.3	0.2
Northampton	4.8	5.7	3.9	1.7	2.2	0.1	4.2	6.5	2.3	1.0	0.3	0.1

Continued

Table 27--Annual livestock and poultry water use by species, Delmarva Peninsula, 1959, 1969, and 1974 (Continued)

Area	Horses and mules 1959	1969	1974	Chickens 3 months and over 1959	1969	1974	Broilers 1959	1969	1974	Turkeys 1959	1969	1974
	Million Gallons											
DELMARVA PENINSULA	27.4	22.9	18.6	20.7	40.3	37.2	466.8	816.9	858.9	5.5	6.0	5.9
Delaware:	11.3	9.8	8.9	10.9	14.9	15.5	213.6	338.7	373.5	4.5	5.1	5.9
Kent	4.6	4.5	3.8	1.9	1.5	2.5	10.2	9.0	13.5	1.2	*	*
New Castle	2.3	2.1	2.0	1.7	2.3	1.9	1.2	1.2	-	0.4	0.5	0.2
Sussex	4.4	3.2	3.1	7.3	11.1	11.1	202.2	328.5	360.0	2.9	4.6	5.7
Maryland:	13.2	12.4	9.3	8.8	20.9	21.1	238.8	452.4	461.4	1.0	0.9	*
Upper Shore--	7.3	8.7	6.5	5.0	4.5	3.1	41.1	83.7	80.1	0.3	*	*
Caroline	1.6	0.7	0.7	1.3	2.6	1.9	30.3	63.6	60.9	0.1	-	*
Cecil	2.1	4.0	3.1	1.7	1.1	0.8	*	0.6	0.3	*	*	*
Kent	0.8	1.1	1.0	0.4	0.1	0.1	-	0.3	0.3	*	*	*
Queen Anne's	1.9	2.3	1.0	0.9	0.5	0.2	1.2	3.3	3.3	*	*	-
Talbot	0.9	0.6	0.7	0.7	0.2	0.1	9.6	15.9	15.3	0.2	*	*
Lower Shore--	5.9	3.7	2.8	3.8	16.4	18.0	197.7	368.7	381.3	0.7	0.9	*
Dorchester	1.0	0.8	0.5	0.9	1.1	1.0	4.5	15.3	17.4	0.1	*	-
Somerset	0.5	0.4	0.4	1.0	4.9	3.5	42.3	84.6	79.5	*	*	-
Wicomico	2.0	1.6	0.7	0.7	6.6	8.4	81.9	155.4	162.0	0.6	0.9	*
Worcester	2.4	0.9	1.2	1.2	3.8	5.1	69.0	113.4	122.4	*	*	*
Virginia:	2.9	0.7	0.4	1.0	4.5	0.7	14.4	25.8	24.0	*	-	-
Accomack	1.8	0.4	0.2	0.9	4.5	0.7	14.1	25.8	24.0	*	-	-
Northampton	1.1	0.3	0.2	0.1	*	*	0.3	-	-	*	-	-

* Less than 50,000 gallons

Source: Rural Water Uses 1950-1960-1970, Chesapeake Bay Study Area, NRED-ERS-USDA, Upper Darby, Pa., April 1973, and Bureau of Census, Census of Agriculture, 1959, 1969, and 1974.

Higher milk production rates per cow and greater use of water for sanitary purposes on dairy farms were primary factors responsible for increased per capita water consumption by milk cows during this period.

The percentage of total livestock and poultry water use accounted for by the consumption of each species in 1959, 1969, and 1974 is shown in Table 28 for the Peninsula as a whole and for each of the subareas. In 1959, consumption by cattle and calves and milk cows accounted for more than 60 percent of livestock and poultry water use, but in 1974 accounted for only slightly more than 40 percent. Broilers, on the other hand, used about 25 percent of the water in 1959, but nearly 40 percent in 1974. Trends within all Peninsula subareas showed similar shifts in water use among animal types.

Irrigation. On the Delmarva Peninsula, irrigation is commonly used only for vegetables, potatoes, and nursery crops. As in other humid areas of the United States, irrigation of field crops such as corn and soybeans and of pasture and hay crops is generally practiced by only a few farmers. In terms of water use, however, irrigation of only a small proportion of harvested cropland can require large volumes of water. One inch of water applied to one acre (an "acre-inch") is equivalent to 27,200 gallons - which would sustain a herd of 25 milk cows for a month at the rate of 35 gallons a day. Moreover, irrigation is a consumptive use of water. Depending upon the efficiency of application, from 65 to 90 percent of the water applied will be "used" as evaporation or transpiration.

Estimates of irrigation water use on the Peninsula are based on irrigation data from the Censuses of Agriculture for 1969 and 1974. Data on the number of Peninsula farms using irrigation, acreage irrigated, and water used are presented in Table 29. Comparison of Table 29 with Tables 25 and 26

Table 28--Annual water use by species as a percent of total livestock and poultry water use, Delmarva Peninsula and subareas, 1959, 1969, and 1974.

Area	Cattle and Calves 1959	1969	1974	Milk Cows 1959	1969	1974	Hogs and Pigs 1959	1969	1974	Sheep and Lambs 1959	1969	1974
						Percent						
DELMARVA PENINSULA	19.7	20.1	20.7	40.5	23.3	21.4	11.2	16.1	15.1	0.7	0.3	0.2
Delaware:	16.1	15.7	16.8	34.5	20.1	17.2	10.2	15.6	15.1	0.5	0.2	0.1
Maryland	21.5	22.5	23.2	44.7	25.9	24.8	11.2	15.7	14.3	0.7	0.4	0.2
Upper Shore	26.1	33.5	35.2	56.4	41.4	42.0	10.3	12.0	9.8	0.7	0.6	0.3
Lower Shore	10.9	8.0	9.3	18.3	5.7	4.7	13.3	20.5	19.4	0.7	0.1	0.1
Virginia	23.7	19.8	16.5	12.5	6.2	4.0	22.5	28.6	34.0	3.9	0.9	0.5

Area	Horses and Mules 1959	1969	1974	Chickens 3 months and over 1959	1969	1974	Broilers 1959	1969	1974	Turkeys 1959	1969	1974
						Percent						
DELMARVA PENINSULA	1.5	1.0	0.9	1.1	1.8	1.7	25.0	37.1	39.7	0.3	0.3	0.3
Delaware	1.8	1.3	1.1	1.8	1.9	2.0	34.4	44.5	46.9	0.7	0.7	0.8
Maryland	1.1	0.9	0.7	0.7	1.5	1.6	20.0	33.0	35.2	0.1	0.1	*
Upper Shore	0.9	1.1	0.9	0.6	0.6	0.4	5.0	10.8	11.4	*	*	*
Lower Shore	1.6	0.6	0.5	1.1	2.8	3.0	54.1	62.1	63.0	*	0.2	*
Virginia	5.9	1.0	0.7	2.1	6.5	1.3	29.4	37.0	43.0	*	--	--

* Less than 0.05%

Source: Calculated from data presented in Table 27.

Table 29--Irrigated acreage and water use, Delmarva Peninsula, 1969 and 1974

Area	Class 1-5 Farms - 1969			Farms with Sales of $2,500 and Over - 1974 1/			Proportion of Farms		Water Used		Inches per Acre	
	Farms	Acres	Acre Feet Used	Farms	Acres	Acre Feet Used	1969	1974	1969	1974	1969	1974
DELMARVA PENINSULA	434.	48,365.	19,381.	389.	43,448.	18,748.	6.5	5.4	6,325.6	6,119.0	4.8	5.2
Delaware:	154.	20,385.	7,452.	142.	19,797.	7,866.	6.7	5.4	2,432.3	2,567.3	4.4	4.8
Kent	66.	10,902.	3,328.	70.	12,143.	4,478.	8.9	8.6	1,084.6	1,461.5	3.7	4.4
New Castle	30.	2,942.	881.	16.	730.	189.	8.0	4.5	289.8	61.7	3.6	3.1
Sussex	58.	6,541	3,243.	56.	6,924.	3,199.	3.4	3.1	1,057.9	1,044.1	5.9	5.5
Maryland:	192.	16,034.	7,004.	176.	16,241.	7,158.	3.9	3.7	2,286.0	2,336.3	5.2	5.3
Upper Shore--	82.	9,836.	4,800.	85.	11,372.	4,635.	3.3	3.3	1,565.8	1,512.8	5.9	4.9
Caroline	41.	5,150.	2,336.	55.	7,553.	3,179.	6.5	8.6	762.6	1,037.5	5.4	5.1
Cecil	6.	210.	106.	5.	199.	189.	1.6	1.4	34.5	61.7	6.1	11.4
Kent	11.	1,646.	1,120.	6.	1,505.	372.	2.7	1.8	365.0	121.4	8.2	3.0
Queen Anne's	18.	2,518.	1,083.	14.	1,946.	821.	4.0	3.1	352.9	268.0	5.2	5.1
Talbot	6.	312.	155.	5.	169.	74.	1.9	1.5	50.8	24.2	6.0	5.3
Lower Shore--	110.	6,198.	2,204.	91.	4,869.	2,523.	4.6	4.1	720.2	823.5	4.3	6.2
Dorchester	30.	1,858.	538.	32.	2,782.	1,245.	7.1	7.8	175.3	406.3	3.5	5.4
Somerset	13.	680.	328.	10.	341.	215.	3.3	2.5	106.9	70.2	5.8	7.6
Wicomico	63.	3,364.	1,271.	47.	1,594.	1,030.	7.6	5.9	416.2	336.2	4.5	7.8
Worcester	4.	296.	67.	2.	152.	33.	.6	.3	21.8	10.8	2.7	2.6
Virginia:	88.	11,946.	4,925.	71.	7,410.	3,724.	17.7	13.1	1,607.3	1,215.4	4.9	6.0
Accomack	45.	6,422.	2,646.	36.	4,087.	2,059.	12.1	9.7	864.6	672.0	4.9	6.0
Northampton	43.	5,524.	2,279.	35.	3,323.	1,665.	23.2	16.4	742.7	543.4	5.0	6.0

Source: Bureau of Census, Census of Agriculture, 1969 and 1974.

1/ Class 1-5 Farms (1969 categorization) and Farms with Sales of $2,500 and Over (1974 classification) can be considered as fairly comparable.

Table 30--Acreage of irrigated crops, Delmarva Peninsula, 1974

Area	Cropland Pasture	Corn	Soybeans	Wheat	Barley	Hay	Irish Potatoes	Vege-tables	Orchard Berries	Nursery & Other	Total
	------------	------------	------------	------------	------------	Acres	------------	------------	------------	------------	------------
DELMARVA PENINSULA	116	3,323	3,816	639	508	161	7,232	25,489	428	2,095	43,807
Delaware:	47	1,418	2,055	374	90	17	3,573	12,212	293	238	20,317
Kent	17	305	918	206	-	7	3,264	7,258	58	188	12,221
New Castle	15	1	-	-	-	-	305	308	19	10	658
Sussex	15	1,112	1,137	168	90	10	4	4,646	216	40	7,438
Maryland:	69	1,758	1,685	250	418	144	4	9,798	100	1,557	15,783
Upper Shore--	54	1,493	1,101	140	243	53	1	6,626	43	1,103	10,857
Caroline	4	915	1,021	140	237	3	1	5,107	36	303	7,767
Cecil	-	-	20	-	-	-	N.A.	N.A.	-	23	43
Kent	-	150	-	-	-	50	-	N.A.	-	675	875
Queen Anne's	50	388	50	-	-	-	-	1,474	7	50	2,019
Talbot	-	40	10	-	6	-	-	45	N.A.	52	153
Lower Shore--	15	265	584	110	175	91	3	3,172	57	454	4,926
Dorchester	-	45	521	70	175	82	2	1,878	27	100	2,900
Somerset	-	70	35	-	-	-	-	115	15	42	277
Wicomico	13	-	28	40	-	9	1	1,179	15	312	1,597
Worcester	2	150	-	-	-	-	-	-	-	-	152
Virginia:	-	147	76	15	-	-	3,655	3,479	35	300	7,707
Accomack	-	22	16	-	-	-	1,510	2,656	-	168	4,372
Northampton	-	125	60	15	-	-	2,145	823	35	132	3,335

Source: Bureau of Census, 1974 Census of Agriculture.

N.A. signifies Not Available.

indicates that irrigated water use in 1974 was 96 percent of rural domestic water use in 1970 and consumed 2.8 times the water use of livestock and poultry in 1974. Table 30 indicates data on irrigated acreage by crop for 1974. Of the 43,448 acres irrigated in 1974, 25,489, or 59 percent, were in vegetables; an additional 7,232 acres, or 17 percent, in Irish potatoes; and 7,139 acres, or 17 percent, in corn and soybeans.

Total agricultural water use in 1969-70 was 14,903.7 million gallons. Of this total, 42.8 percent was rural domestic water use; 14.8 percent was used by livestock and poultry; and 42.4 percent was irrigation use. Rural domestic water use nearly doubled between 1950 and 1970 and livestock and poultry water use also increased 16.0 percent between 1950 and 1969. Future agricultural water use will depend on changes in all of the components of use: rural population growth, per capita use rates, and homes served by running water; livestock and poultry production and per capita use rates; and cropping patterns, climatic conditions, and production technology. Analysis of existing trends, however, would indicate that the rate of increase in agricultural water use in the future will probably decline, but no absolute decrease in water use can be expected unless there are dramatic shifts in the Delmarva agricultural economy.

SUMMARY

Despite its proximity to the eastern megalopolis, the Delmarva Peninsula is still essentially rural. Typical of most rural areas, the Peninsula's population growth has exceeded the growth of employment opportunities. As a result, workers (particularly young adults) have left the Peninsula to seek employment in adjacent metropolitan areas. The remaining population thus has a greater concentration (than the United States as a whole) of those least able by age and education to migrate. Atypical of most rural areas, however, the Peninsula has unique recreational assets and cultural features. As access to the Peninsula has been improved, development of these assets provided an economic stimulus that has had an impact throughout the Peninsula. Increasing land values and competition for available labor has resulted in the development of more intensive agricultural systems with a subsequent increase in farm income. Along with recreational development, this growth has been conducive to the development of the non-farm economy and resulted in an overall improvement in social well-being.

Further development of the Peninsula's land and water resources, however, will require careful planning to assure that the impacts of development do not detract from the Peninsula's environment (including its rural landscape) or induce changes in the region's economy that will result in the dislocation of Peninsula residents. Similarly, careful planning will be required to assure that development required

to sustain continued economic and social growth will be forthcoming. Given the resources of the Peninsula and their attraction for residents of the area, the states involved, and the nation at-large, the needs of all groups concerned must be recognized and considered in the planning process. Only a broad consensus of goals and means to achieve them will assure their attainment.

APPENDIX A

United States Census of Agriculture: History, Farm Definitions and Comparability of 1959 through 1974 Data

HISTORY

The Constitution of the United States requires that a General Census--a national enumeration of the population--be conducted every ten years. Between 1840 and 1920 supplementary agricultural data was collected in conjunction with the General Census.

However, by the turn of the century, because of the increased application of scientific knowledge, the growing mechanization of agriculture, and rapidly changing farm practices, the facts collected at 10-year intervals were no longer adequate. So beginning in 1920, a separate Census of Agriculture was conducted once every 5 years.

FARM DEFINITIONS

Over the years various factors such as increased mechanization, intensification, specialization, productivity, and inflation have reshaped the basic structure of the agricultural units which produce food and fiber. So, from time to time, it has been necessary to change the official Census of Agriculture definition as to what exactly constitutes a farm for statistical purposes in order to more accurately reflect prevailing conditions. The two most recent changes occurred in 1959 and 1974.

1959 Farm Definition

For the 1959, 1964, and 1969 Census of Agriculture the definition of a farm was based primarily on a combination of acreage and value of agricultural products sold.

*Places of <u>less than 10 acres</u> in the census year were counted as farms <u>if</u> the estimated sales for the year amounted to at least <u>$250</u>.

*Places of <u>10 or more acres</u> in the census year were counted as farms <u>if</u> the estimated sales of agricultural products for the year amounted to at least <u>$50</u>.

*Places having <u>less than</u> the <u>$50 or $250</u> minimum estimated sales in the census year were also counted as farms <u>if</u> they could <u>normally</u> be <u>expected to</u> produce agricultural products in sufficient quantity to <u>meet</u> the <u>requirements</u> of the definition.

In 1969 about 471,000 farms had sales of less than $1,000. These farms comprised 20.9% of all farms but contributed less than 1% of total sales.

<u>1974 Farm Definition</u>

Between 1969 and 1974, during a period of inflationary pressure, many small farms ceased operation, while many others had sales of $1,000 or more, either because of increased agricultural activity or because of increases in the per unit value of agricultural products sold. By 1974, there were only about 152,000 farms with sales of less than $1,000. These farms accounted for less than 6 hundredths of 1% of total sales.

In 1974 the Census definition of a farm was modified in order to more accurately reflect the structural changes and increased price levels experienced by the agricultural sector during the previous five years. The acreage criterion was deleted and the minimum value of agricultural products sold was increased to $1,000.

For the 1974 Census of Agriculture the definition of a farm was based <u>only</u> on the <u>value</u> of agricultural products sold.

*Places on which agricultural operations were conducted at any time in the census year under the day-to-day control of an individual management and from which $1,000 or more of agricultural products were sold during the census year were counted as farms.

*Places having less than the minimum $1,000 sales were also counted as farms if they could normally be expected to produce agricultural products in sufficient quantity to meet the requirements of the definition.

COMPARABILITY OF DATA

In 1959 farms were divided into six economic classes on the basis of the total value of all farm products sold.

Class of Farm	Value of Farm Products Sold		
I	$40,000 and over	OVER $2,500--Comparable to 1974 data	ALL FARMS--Not comparable to 1974 data
II	$20,000 to $39,999		
III	$10,000 to $19,999		
IV	$5,000 to $9,999		
V	$2,500 to $4,999		
VI	$50 to $2,499	UNDER $2,500--Not comparable to 1974 data	

These six classes, each containing the number of farms within a prescribed income range, formed the basic unit of data. However, by combining adjoining classes, additional categories, which encompass a greater number of farms with a broader income range, can be created. For example, by combining Classes I through V, the number of farms which sold OVER $2,500 of agricultural products in 1959 can be obtained. And by adding the over $2,500 category to the Class VI or UNDER $2,500 category the total number of ALL FARMS can be determined.

In 1974 farms were divided into only two--not six--economic categories.

Value of Farm Products Sold

Over $2,500	OVER $2,500--Comparable to 1959 data	ALL FARMS--Not comparable to 1959 data
$1,000 to $2,499	UNDER $2,500--Not comparable to 1959 data	

Though providing only two basic units of data, an ALL FARMS total can be obtained by combining the OVER $2,500 and UNDER $2,500 categories.

For purposes of comparison, in the 1959 Census of Agriculture the UNDER $2,500 classification ranged from $50 to $2,499 while in 1974 the range extended from $1,000 to $2,499. Because of the change in the lower limit the data in the UNDER $2,500 categories for 1959 and 1974 are NOT COMPARABLE.

The ALL FARMS total is the sum of the UNDER and OVER $2,500 categories with the lower limits of the UNDER $2,500 category forming the lower limits of the ALL FARMS total. But because the lower limits ($50 and $1,000, respectively) of the ALL FARMS categories differ, the data in the ALL FARMS categories for 1959 and 1974 are NOT COMPARABLE.

Comparability between 1959 and 1974 data only exists in the OVER $2,500 category. The categories encompassing FARMS with $2,500 or MORE total value of sales for 1959 and 1974 are COMPARABLE because the upper and lower limits of these categories are identical for both years and were not affected by the change in farm definition.

However, it should be noted that even among the OVER $2,500 categories several factors, such as inflation, time of enumeration, and method of collection, have affected comparability to some extent.

Dramatic changes in rates of farm expenditure and unit prices of products sold between the 1969 and 1974 censuses affected the comparability of some census data. During the period between the two censuses, prices paid by farmers greatly increased. Prices received by farmers also increased but with wide fluctuations among commodities at different times during the census year of 1974.

Field work counting of various agricultural commodities for the 1964 and 1959 censuses was completed largely in October, November, and December of the reference year. More recent censuses have requested data be reported as of the end of the calendar year.

Censuses prior to 1969 were taken by enumerators, each assigned to a specific geographic area. Beginning in 1969 and continuing in 1974 enumerations were conducted by mail and direct interviews with farm operators were eliminated.

DELMARVA'S WILDLIFE WORK GROUPS' PROCEDURE FOR HABITAT ANALYSIS

APPENDIX C

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FOREWORD: The Delmarva Wildlife Work Group's procedure for wildlife habitat evaluation refined a procedure for comprehensible and sound development of data collection and analysis. This effort created an accepted format for communications between individual biologists and other professions. Work group consensus of particular wildlife habitat values including a quantity of land use, interspersion and management conditions were much more applicable than individual interpretations. This procedure permits prediction of future wildlife habitat values on lands with various planned activities versus unplanned activities. Application of the procedure involved 150 volunteer participants collecting data on 19,425 km^2 at 60,000 sites.

INTRODUCTION

The Delmarva Peninsula is experiencing a growing conflict between agricultural, fish and wildlife, and environmental interests. An important goal of the Delmarva River Basins Survey has been to help resolve these conflicts and enhance the complementary situations. Data had to be developed to aid in identification of situations which were complementary or conflicting. There was also a need to identify habitat components of high value to fish and wildlife for their protection and to highlight these factors.

Major requirements of an analysis system are that it be comprehensible and sound so data can be supported. It should also be designed so individuals with different backgrounds can use the system, thus creating an acceptable tool of communication. To achieve this task a wildlife work group was established composed of fishery biologists, wildlife biologists, botanists, foresters, mathematicians and personnel from other professions. The first task was to list the major environmental influences affecting the quality of the habitat. Various factors that needed to be surveyed such as hedgerow position, edge effect, management or vegetative condition, size of units, spatial relationships between land uses, human population and development related disturbance factors were identified.

A procedure was needed to establish a data base to quantify, appraise, and compare areas for their relative wildlife habitat values. The scope of the project was to gather data on 19,425 km^2 or approximately 1,902,063 ha of land and water comprising the Delmarva Peninsula, so accurate evaluations could be made for any land unit of 6,070 ha or larger. A methodology was needed to analyze the data and display land

based fish and wildlife habitat relations. The basic model developed by Whitaker and McCuen (1975) [1] was modified for use by the work group. The sampling procedure and the methods for evaluating inventoried conditions were expanded and refined.

In the design of data collection and analysis the work group stressed the need to be able to retrieve data for any geographical or political unit. A stratified random point sampling procedure was used to sample conditions which could be proportionally displayed for analytical purposes. Distance measurements were applied to display the spatial relationships between land uses.

Personnel from the states of Maryland, Delaware, Virginia, private organizations, and federal agencies were involved in the survey and are too numerous to acknowledge individually. Special thanks go to John Wenderoth for implementation of the technique for deriving the species-habitat weights consensus from the work group and to Lawrence Robinson for his creativity and review of the procedure.

METHODS

Appropriate scale conversions were selected to produce two overlay stencils on a stable mylar base, one for aerial photos of 1:15840 scale and one for use as a control with USGS topographic sheets (quad sheet) of 1:24000 scale. The topographic sheets were also used to stratify the sampling procedure. The point numbering procedure was designed to allow ease of data retrieval and analysis. Six hundred sample points were randomly placed on the quad sheet mylar forming a stencil. Another stencil was produced by expanding these points to transfer to actual photos after formation of a mosaic.

Each point was given an identification number. A reference list was developed using the identification numbers as each point was pinpricked through the stencil and the point identification number recorded on the back of the photo. This recorded list was referenced when key punching identification on specially developed IBM Z26208 port-a-punch cards. The cards were selected to increase efficiency in handling field data. All data, including measurements were documented on the cards.

Data collection was organized by quads for ease of field use.

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1 G. A. Whitaker and R. H. McCuen. 1975. A Proposed Methodology for Assessing the Quality of Wildlife Habitat. Technical Report, Department of Civil Engineering, University of Maryland, College Park. 34 pp.

INVENTORY KEY

A major task of the wildlife work group was defining land use and management or vegetative conditions that were meaningful divisions relative to wildlife habitat values. Creation of a land use and management condition key was the result of this effort. Five major land uses were defined: (1) cropland, (2) herbaceous land, (3) rural residential-commercial, (4) water dominated areas (wetlands), and (5) woodland.

Woodland was further subdivided to segregate values generally held by various habitat components for wildlife. Other components of the inventory key included vegetative strips and important miscellaneous field observations.

A dichotomous key was designed for the inventory of land use types by the Delmarva Wildlife Work Group in 1976. The key segregated types and established subdivisions under each major habitat component. Cropland was differentiated into 21 subdivisions. Herbaceous land, rural residential-commercial, and water dominated areas had 10 divisions each. Woodland the most diverse of the groups was divided into (1) understory density, with 3 divisions, (2) woody understory composition, with 8 divisions, (3) dominant species group, with 10 divisions, and (4) dominant tree size, with 7 divisions.

The woodland key was developed by a woodland subcommittee over a two-week field review and development period. Foresters and wildlife biologists were involved in the formation of the key. A wildlife subcommittee developed and tested the rest of the key using similar procedures (see List 1).

The dichotomous key was field tested by three groups of professionals. A sample set of points was observed and interpreted by each group independently. The groups compared codes they assigned to each site. Results indicated agreement in almost all cases. Field application of a random point survey stresses the need to locate each point in the field realizing that it is a random point and any point chosen becomes representative of an area unit.

Point Definition

A point was defined as that location on the photo which had been designated by the pinprick. The woodland interpretation required investigation of additional surrounding area to develop a better insight to habitat values.

Understory determination was achieved by investigating the area surrounding the point irrespective of the size of the area. Generally, the determination of the tree species and tree size was achieved by investigating within a radius of 30.5 m from the pinpricked point. The dominant species and size were determined by viewing trees which comprised 50 percent or greater of an aerial view.

List 1:

Delmarva River Basins Survey
Land Use and Management Condition Key

Cropland... 00-29

- Areas actively used for the production of annual crops, perennial crops, orchards, and nurseries.

Herbaceous land.................................... 30-49

- Areas dominated by herbaceous growth and includes such land as pasture land, hay land, idle land, and power right-of-ways.

Rural Residential-Commercial....................... 50-59

- Commercial Areas - Building and the areas associated with their function, roads, and active construction areas.

Water Dominated Areas.............................. 60-69

- Open water and herbaceous wetlands.

Woodland... 7000-9999

Vegetative Strips, including hedgerows nearest to field point used in measurements.

Key to miscellaneous field observations.

Cropland

(November-March Observable Conditions)

			Code
A.	Grain and vegetable production areas	B	
A.	Orchards, nurseries, etc.	R	
B.	Ground tilled previous crop not identifiable		01
B.	Present or previous crop identifiable	C	
C.	Vegetables	D	
C.	Grains	H	
D.	Live vegetables, mainly perennials, (i.e. - asparagus, cabbage, strawberries)		02
D.	Annual vegetables with identifiable residue	E	
E.	Annual vegetables - not tilled	F	
E.	Annual vegetables - light tillage	G	
F.	Vegetable residue with annual weeds abundant		03
F.	Vegetable residue without annual weeds of value to wildlife		04
G.	Vegetable residue lightly tilled (sparse cover or few seeds available)		05
G.	Evidence of vegetable residue in cover or grain crop present		06
H.	Small grain - residue or growing (wheat sorghum, barley, buckwheat, etc. residue of large grain crop not evident)	I	
H.	Large grain (corn or soybeans) residue evident	J	
I.	Live grain or cover crop - previous crop not identifiable		07
I.	Small grain stubble (i.e. - sorghum, buckwheat)		08

			Code
J.	Corn residue evident	K	
J.	Soybean residue evident	O	
K.	Corn harvested - no further use or management of stubble	L	
K.	Corn harvested - with further management of stubble	M	
L.	Corn cut for silage only		09
L.	Corn picked or combined only		10
M.	Corn lightly tilled, grazed or mowed		11
M.	Corn residue with cover crop	N	
N.	Corn residue plentiful in cover crop (readily available to wildlife)		12
N.	Corn residue scarce in cover crop (not readily available to wildlife)		13
O.	Soybeans harvested - not tilled, grazed, or mowed	P	
O.	Soybeans harvested with tillage or cover crop present	Q	
P.	Soybean stubble in old grain stubble (no till soybeans)		14
P.	Soybean stubble only		15
Q.	Soybeans, tilled, grazed, or mowed		16
Q.	Soybeans residue with cover crop		17
R.	Multiple species nurseries	S	
R.	Orchards or monospecies nurseries	T	
S.	Multiple species nurseries with over 25 percent herbaceous growth		18
S.	Multiple species nurseries with clean soil or less than 25 percent herbaceous growth		19
T.	Orchards or monospecies nurseries with over 25 percent herbaceous growth		20
T.	Orchards or monospecies nurseries with less than 25 percent herbaceous growth		21

Herbaceous Land

			Code
A.	Woody growth, including seedling trees, shrubs, vines, and briars, not present	B	
A.	Woody growth, including seedling trees, shrubs vines, and briars, present		(See Woodland Key)
B.	Vegetation appears not planted, mowed, grazed or otherwise managed	C	
B.	Vegetation appears planted, mowed, grazed, or otherwise managed	F	
C.	Vegetation resulting from recent disturbance (mainly annuals - ragweed, foxtail, etc.)	D	
C.	Vegetation mainly well established perennials (aster, beggartick, goldenrod, etc.)	E	
D.	A wide variety of species including some green winter annuals		30
D.	One or two small seeded species (i.e. - crabgrass) dominant and insignificant amount of green winter annuals present		31
E.	A wide variety of species present or dominated by beggarticks or an understory of green winter annuals obvious		32
E.	One or two species dominant (i.e. - broomsedge or dry site phragmites)		33
F.	Planted species not otherwise managed	G	
F.	Planted or native species showing recent evidence of mowing or grazing	H	
G.	One or two species dominant in solid stand		34
G.	A variety of planted species or stand being invaded by native species		35
H.	Mowed areas not obviously pastured	I	
H.	Pastureland	J	
I.	Hayland or sod farm (Note if sod farm)		36
I.	Mowed areas of native species		37

			Code
J.	Well managed or lightly grazed pasture (irregular appearance - clumps of ungrazed vegetation abundant) vegetation greater than 4 inches high)		38
J.	Heavily grazed (most of the vegetation less than 4 inches high)		39

Rural Residential-Commercial

A.	Commercial area, road, and miscellaneous unvegetated areas including bare sand and spoil	B	
A.	Residential or farmstead and other principally vegetated areas	E	
B.	Commercial land use	C	
B.	Miscellaneous unvegetated areas	D	
C.	Commercial property with little or no woody vegetation (less than 10 percent shrubs or trees)		50
C.	Commercial property with more than 10 percent woody shrubs or trees		51
D.	Roads, etc. (pavement or shoulder, parking lots - essentially permanently unvegetated)		52
D.	Construction areas - essentially no vegetation (bare sand and spoil, see miscellaneous Note 9)		53
E.	Farm headquarters or residential property	F	
E.	Other miscellaneous principally vegetated areas	I	
F.	Farm headquarters	G	
F.	Residential property	H	
G.	Areas regularly mowed and less than 25 percent trees and shrubs		54
G.	Weedy areas abundant and/or over 25 percent shrub and tree cover		55
H.	Shrub and tree cover less than 25 percent		56
H.	Shrub and tree cover more than 25 percent		57
I.	Principally vegetated, road and other rights-of-way		58
I.	Miscellaneous principally vegetated intensively used area (i.e. - ballfields, city parks, golf courses)		59

Water Dominated Areas

		Code
A. Coastal wetlands and open water areas [1] (in rivers - downstream from where the rivers are 400 feet wide or greater)	B	
A. Inland areas - all areas landward of a restricted water area less than 400 feet in width (this line will be drawn on each photo for permanent record)	C	
B. Permanent open coastal water including mud flats exposed at low tides (only that area within 200 feet of vegetated marsh will be recorded		60
B. Areas dominated by established long duration herbaceous vegetation [2] (normally inundated by high tide)		61
C. Open water	D	
C. Areas dominated by established long duration herbaceous vegetation [2]	G	
D. Ponds	E	
D. Flowing streams and rivers		62
E. Large ponds	F	
E. Ponds less than 1/2 surface acres		63
F. Ponds 1/2 to 3 surface acres		64
F. Ponds larger than 3 surface acres		65
G. Areas not affected by tidal action	H	
G. Areas along tidal rivers	I	
H. The soil is covered with 6 inches to 3 feet or more of water during the growing season		66
H. The soil is usually waterlogged during the growing season; often it is covered with as much as 6 inches or more of water (sometimes cropped or tilled)		67

1 Includes coastal marshes protected from open water by natural or man constructed sand dunes, spoil piles, or protective structures.
2 Wooded wetland included as a woodland type.

			Code
I.	Regularly covered by water (low tide marsh)		68
I.	Irregularly covered by water (high tide marsh)		69

Woodland

(Four digit number)

Understory Density:			1st digit
A.	Understory sparse or absent		7
A.	Understory medium or heavy	B	
B.	Understory medium, easy to walk through		8
B.	Understory heavy, difficult to impossible to walk through		9

Woody Understory Composition:			2nd digit
A.	Understory vegetation obvious	B	
A.	Understory essentially lacking	G	
B.	Conifers and other evergreens comprising greater than 5 percent	C	
B.	Conifers and other evergreens comprising less than 5 percent	F	
C.	Conifers predominant	D	
C.	Other evergreens predominant	E	
D.	Conifers and other evergreens greater than 50 percent		0
D.	Conifers and other evergreens less than 50 percent		1
E.	Evergreens comprise greater than 50 percent		2
E.	Evergreens comprise less than 50 percent		3
F.	One or two species predominant		4
F.	Three or more species predominant		5
G.	Essentially no understory		6
G.	Recent cutover areas with little or no live vegetation (may have considerable slash)		7

Dominant Species Group:		Code 3rd digit
A. Coniferous present contributing 5 percent or more to canopy	B	
A. Coniferous absent or less than 5 percent of canopy	F	
B. Over 95 percent coniferous		0
B. Less than 95 percent coniferous	C	
C. Over 50 percent coniferous	D	
C. Less than 50 percent coniferous	E	
D. Over 50 percent coniferous with upland deciduous trees (mainly nut producers - i.e. - oaks)		1
D. Over 50 percent coniferous with bottom deciduous trees - i.e. - maple and gum		2
E. Less than 50 percent coniferous with upland deciduous (i.e. - oaks)		3
E. Less than 50 percent coniferous with bottomland deciduous trees - i.e. - maple and gum		4
F. Deciduous with cypress		5
F. Deciduous without cypress	G	
G. Stand dominated over 50 percent by one or two species - i.e. - maple, oaks, sweetgum	H	
G. Stand not dominated by one or two species	I	
H. Oaks and other nut producers comprise over 50 percent crown cover		6
H. Maple and/or gum singularly or in combination comprise over 50 percent crown cover (monoculture)		7
I. A mixture of upland deciduous species (not dominated by one or two species) including beech, hickory, oak, cherry, tulip poplar, and other less common hardwood species		8
I. A mixture of bottomland deciduous species (not dominated by one or two species - i.e. - maple, gum)		9

			Code
I. (cont'd.) species including sycamore, willow, birch, cottonwood, and tulip poplar			
Size: (comprises 50 percent or greater of area)			4th digit
A. Trees less than 2 inches DBH		B	
A. Trees greater than 2 inches DBH		D	
	B. Seedling trees, brush and vines with less than 15 percent woody growth <u>or</u> subcanopy of seedling pine	F	
	B. Seedling trees, brush, and vines with greater than 15 percent woody growth	C	
	C. Seedling trees, brush, and vines with greater than 15 percent woody growth but less than 60 percent woody growth		1
	C. Seedling trees with or without brush and vines with greater than 60 percent woody growth		2
	D. Trees greater than 2" DBH but less than 6" DBH (sapling)		3
	D. Trees greater than 6" DBH	E	
	E. Trees greater than 6" DBH but less than 12" DBH (post and pole)		4
	E. Trees greater than 12" DBH (saw timber)		5
	F. Woodland management practices evident (indicates pines planted or apparently will be planted)		6
	F. Woodland management practices not evident		7

Vegetated Strips

(Strip nearest point to be typed as a 3 digit number)
Ignore vegetative strips along roads unless they are over 40 percent woody.

Type:	1st digit
Greater than 40 percent woody less than 15 feet high	1
Greater than 40 percent woody 15 to 30 feet high	2
Greater than 40 percent woody over 30 feet high	3
Mainly herbaceous vegetation (less than 10 percent woody)	4
10 percent to 40 percent woody (seedling trees, brush and vines with herbaceous growth	5

	Code
Width:	2nd digit
Less than 15 feet wide	1
15 to 35 feet wide	2
35 to 100 feet wide	3
Position:	3rd digit
Along and/or in a ditch or waterway	1
Along a field, driveway, or fence property boundary (not also a ditch)	2
Along a public road (recorded only if over 40 percent woody)	3
Along a woods	4
Along public road <u>and</u> ditch (recorded if over 40 percent woody)	5

Miscellaneous Notes

(N Column - to be recorded for points when appropriate)

Note placed on photo..	0
Holly present in woods - 10 percent or more..................	1
Cull Trees - less than 50 percent............................ (Large trees, generally left by recent timber harvest)	2
Wet Areas in an open field dominated by water tolerant herbaceous vegetation but not a permanent wetland area (includes Types 1 and 2 wetland areas)...........................	3
Surface mined land...	4
Sod farm...	5
Natural green cover crop covering 70 percent of ground.......	6
Actively managed for wildlife................................	7
Presently standing crop......................................	8
Bare Sand (naturally occurring unvegetated area).............	9

If existing land use is not clear on photo, use the following codes:

<u>C</u> - Cropland	<u>V</u> - Herbaceous vegetation
<u>W</u> - Woodland	<u>R</u> - Residential or Commercial Area
<u>H</u> - Woody hedgerow	<u>A</u> - Apparent feature is gone
	<u>RA</u>- Apparent building abandoned

FIELD PROCEDURE AND MATERIALS

All of approximately 150 participants worked in natural resource oriented jobs and were equipped with necessary equipment and materials. Participants were instructed in the use of the key by the same individual to limit variance of interpretation. At least one day of field instruction was included in the orientation to insure a uniform working knowledge of the procedure. Assignments for collection of data were distributed by quad sheets. Field investigations were performed in December 1975 and January through February 1976 due to the static nature of vegetation.

Field procedure was to locate the general area by use of the quad sheet and road maps and then refer to the aerial photo index sheet to determine the exact photo needed for specific locations. The next step was to locate the pinprick sample site. The IBM card for the point was then retrieved from the deck of IBM cards which had been prepunched with quad sheet, point and photo identification numbers. The field site was located by the investigator from features on the photo and examined. Determinations were coded according to the key and recorded on the IBM card. This process was repeated until approximately 60,000 sites had been sampled.

OFFICE PROCEDURE

Each point was inspected using various resource reference materials to determine the county, soil type, river basin and watershed for inventory and analysis. This information was also punched on the IBM card.

All cards were subsequently transferred to an IBM diskpack to reduce storage space and facilitate data retrieval.

VALUE JUDGEMENT PROCEDURE

The wildlife work group implemented a sampling procedure to express variability of habitats. Any given area can be significantly different in its ability to sustain wildlife from another area or that same area with manipulation.

Indicator species were used to develop an index of total habitat value for wildlife. Sixteen species were chosen for appraisal. Species were selected to appraise a wide range of habitat values, some associated with openland areas, others with woodland and still others with edge.

Indicator species included representatives from game and nongame to achieve a rounded interpretation. Additional species could easily be included in the appraisal. Species chosen were: bobwhite quail (Colinus virginianus), cottontail rabbit (Sylvilagus floridanus), gray squirrel (Sciurus niger), whitetailed deer (Odocoileus virginianus), mourning dove (Zenaidura macroura), Canada goose (Branta canadensis), eastern wild turkey (Meleagris gallopavo), meadow vole (Microtus pennsylvanicus), deer mouse (Peromyscus leucopus), meadowlark (Sturnella magna), mockingbird (Mimus polyglottos), wood thrush (Hylocichla mustelina), red fox (Vulpes fulva), raccoon (Procyon lotor), kestrel (Falco sparverius), black racer (Coluber constrictor).

The basic requirements of a species are food, cover and water (Leopold 1936).[2] How well an area supplies these requirements can be indexed through interpretation of three major factors: (1) management condition or vegetative type, (2) interspersion of land uses, and (3) quantity of land use.

These factors vary in relative importance when assessing habitat for any particular species. Based on the importance to a species each factor was assigned a numerical weight such that the sum of the three weights equalled 100.

The degree of disturbance by man is an additional factor which affects the ability of the habitat to sustain wildlife and was applied in development of transformation curves.

Management Condition. The relative value of each land use management condition or vegetative type (habitat component) can differ for each species (Table 1). The importance of each land use must also be quantified as a weight to be applied in the evaluation procedure. The relative value of each management condition or vegetative type and the magnitude of weights is only indirectly available from the literature on various species. Ultimately, the assignment of weights must be derived from the experience and knowledge of wildlife biologists familiar with each species and its habitat requirements.

To reduce the time involved in committee and to accurately account for a range of diverse opinions, an independent evaluation of habitat components was requested from each wildlife biologist with working field knowledge of the selected species and the habitat definitions employed during the survey. Each biologist was asked to assign weights, ranging from 1 to 99, to habitat components for a given species. Emphasis was placed on the species needs during critical

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2 A. Leopold. 1933. Game Management. Charles Scribner's Sons, New York. 481 pp.

Table 1 - Management condition index values.

Key Codes	Brief description	Quail	Rabbit	Squirrel-gray	Deer	Dove	Geese	Turkey	Field mice	Deer mice	Meadowlark	Mockingbird	Wood thrush	Fox	Raccoon	Kestrel	Black racer
01	Crop not identifiable (ground tilled)	01	01	01	01	03	09	01	02	01	01	01	01	01	01	01	01
02	Vegetables, live, perennial	06	84	10	70	03	28	12	39	14	16	11	10	26	60	23	18
03	Veg., residue, annual weeds abundant	75	60	16	43	80	30	90	92	72	97	56	64	95	60	97	79
04	Veg., residue, no annual weeds	12	21	07	23	21	19	09	25	23	34	18	14	23	34	19	12
05	Veg., residue, lightly tilled (cover and seeds sparse)	15	13	03	10	16	13	09	15	06	19	08	06	12	11	14	10
06	Veg., residue in cover or grain crop	11	59	12	50	32	60	50	41	26	35	09	12	45	24	44	35
07	Small grain or cover crop - previous crop unidentifiable	10	50	10	52	15	68	48	30	18	21	09	10	25	09	35	19
08	Small grain stubble (sorghum, buck-wheat, etc.)	68	25	05	12	81	39	78	83	60	93	55	45	75	36	85	65
09	Corn harvested - silage	40	11	17	17	52	55	39	35	19	37	19	09	28	25	36	14
10	Corn picked or combined	92	37	89	86	94	93	83	70	45	75	41	37	62	82	69	59
11	Corn lightly tilled, grazed, or mowed	50	12	75	62	81	86	43	40	25	46	15	16	41	59	48	20
12	Corn in cover crop, residue plentiful	65	58	74	97	74	97	83	67	43	48	29	26	66	89	64	47
13	Corn in cover crop, residue scarce	11	48	22	55	41	79	63	37	18	20	14	21	33	22	39	24
14	Soybeans no-till, old grain stubble evident	99	44	47	59	84	67	63	77	49	77	38	42	78	56	82	74
15	Soybeans stubble only	97	21	40	47	54	71	53	50	29	25	33	22	48	28	49	29

Table 1 - Management condition index values.

Key Codes	Brief description	Quail	Rabbit	Squirrel-gray	Deer	Dove	Geese	Turkey	Field mice	Deer mice	Meadowlark	Mockingbird	Wood thrush	Fox	Raccoon	Kestrel	Black racer
16	Soybeans lightly tilled, grazed, or mowed	66	14	27	31	37	58	39	28	11	12	28	08	28	16	27	20
17	Soybeans in cover crop	74	57	17	64	44	86	65	48	23	19	27	24	43	43	43	34
18	Nursery multi-species > 25 percent herbaceous growth	55	98	29	75	77	03	49	87	92	73	97	97	95	62	79	98
19	Nursery multi-species < 25 percent herbaceous growth	35	53	23	41	38	02	21	42	60	31	81	80	45	39	30	47
20	Mono-species or orchard > 25 percent herbaceous growth	45	79	23	76	54	01	38	82	91	75	87	76	84	64	77	95
21	Mono-species or orchard < 25 percent herbaceous growth	30	32	21	45	27	01	18	37	53	29	71	57	38	40	30	50
30	Voluntary annuals, wide variety	98	61	19	47	93	15	86	99	50	99	77	19	83	43	99	77
31	Voluntary annuals, 1 or 2 dominant species (i.e. - crabgrass)	17	22	07	17	99	18	70	79	44	67	49	17	65	32	74	65
32	Voluntary perennials, wide variety of veggarticks, green winter annuals	84	96	22	78	86	18	86	97	70	85	63	38	97	66	94	98
33	Voluntary perennials, 1 or 2 species dominant (i.e. - broomsedge)	21	31	02	22	22	08	19	77	58	56	20	13	63	32	59	69
34	Planted 1 or 2 species dominant	11	29	12	33	10	48	25	61	22	62	25	13	48	22	48	52

Table 1 - Management condition index values.

Key Codes	Brief description	Quail	Rabbit	Squirrel-gray	Deer	Dove	Geese	Turkey	Field mice	Deer mice	Meadowlark	Mockingbird	Wood thrush	Fox	Raccoon	Kestrel	Black racer
35	Planted wide variety of species, or being invaded by native species	78	86	21	78	54	89	66	82	44	90	55	31	87	47	81	75
36	Hayland mowed, not pastured	25	48	10	74	26	97	61	65	26	96	22	10	65	22	77	50
36N	Sod farm	03	08	05	14	02	52	04	02	02	13	02	02	03	02	02	07
37	Mowed areas of natural species not pastured	28	38	12	37	27	62	33	61	39	76	24	25	58	29	53	53
38	Well managed or lightly grazed pasture, vegetation 4" high or greater	18	53	15	63	14	87	53	46	26	84	20	12	52	22	59	55
39	Heavily grazed pasture, vegetation < 4" high	04	07	09	32	14	60	18	12	07	19	10	03	10	04	17	15
	Seedling tree groups, < 2" DBH	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Brush and vines, < 15 percent woody	95	99	70	99	44	02	68	91	91	40	91	82	94	83	82	93
	15-60 percent woody, > 5 percent conifers	80	85	73	91	44	02	51	61	83	21	91	83	78	77	57	86
	15-60 percent woody, > 95 percent deciduous	81	83	95	93	33	02	56	67	89	19	94	85	81	91	55	82
	> 60 percent woody, > 5 percent conifers	53	41	51	76	28	01	42	28	74	03	73	92	51	62	20	75
61	Coastal, permanent herbaceous	12	10	02	70	03	07	10	02	02	17	01	01	03	95	33	01
66	Inland non-tidal, water present growing season	13	06	01	39	01	20	06	02	00	01	01	01	03	90	41	01
67	Inland non-tidal, soil usually water-logged, occassionally tilled	20	20	01	40	01	04	07	20	00	20	01	01	07	40	44	01

Table 1 - Management condition index values.

Key Codes	Brief description	Quail	Rabbit	Squirrel-gray	Deer	Dove	Geese	Turkey	Field mice	Deer mice	Meadowlark	Mockingbird	Wood thrush	Fox	Raccoon	Kestrel	Black racer
68	Inland tidal, low tide marsh	05	04	01	38	01	02	01	02	00	01	01	01	02	76	30	00
69	Inland tidal, high tide marsh	08	07	01	48	01	03	02	02	00	01	01	01	04	85	36	00
50	Commercial areas < 10 percent woody vegetation	05	08	03	07	04	09	01	15	11	19	29	01	04	08	16	17
51	Commercial areas > 10 percent woody vegetation	20	27	22	14	27	08	02	27	36	22	75	46	21	35	27	20
52	Roads, parking lots, etc. (previously unvegetated)	02	01	02	01	01	01	01	01	01	01	01	01	01	02	02	01
53	Construction area and miscellaneous unvegetated area	01	01	01	01	06	01	01	01	02	01	02	02	01	01	01	01
54	Farm headquarters - regularly mowed < 25 percent woody	25	21	14	11	56	50	07	36	15	27	52	12	14	22	22	42
55	Farm headquarters - weedy areas abundant > 25 percent woody	99	99	26	14	99	28	08	84	88	30	88	87	48	81	51	78
56	Residential area < 25 percent woody	18	22	19	10	23	16	04	38	28	27	79	24	11	32	17	25
57	Residential area > 25 percent woody	85	73	99	12	45	11	04	52	63	25	99	99	21	76	17	33
58	Roads and rights-of-way -- vegetated	80	97	16	99	98	41	99	97	90	99	57	37	99	72	99	99
59	Miscellaneous principally vegetated vegetated areas (ball fields, parks, etc.)	89	79	81	64	92	99	61	50	89	88	69	96	78	99	79	71

Table 1 – Management condition index values.

Key Codes	Brief description	Quail	Rabbit	Squirrel-gray	Deer	Dove	Geese	Turkey	Field mice	Deer mice	Meadowlark	Mockingbird	Wood thrush	Fox	Raccoon	Kestrel	Black racer
	Understory (1st and 2nd digits):																
76	Sparse – no woody species	10	01	01	01	00	00	14	00	01	00	01	01	01	01	00	01
	Sparse – a few shrubs	15	11	12	09	00	00	38	00	03	00	08	12	10	05	00	04
82	Medium – conifers and other evergreens > 50 percent	28	33	13	16	00	00	26	00	15	00	38	28	32	48	00	23
83	Medium – conifers and other evergreens < 50 percent	85	49	62	42	00	00	46	00	43	00	67	54	66	56	00	42
	Medium – evergreens > 50 percent (< 5 percent pine)	25	39	28	48	00	00	31	00	26	00	41	43	40	48	00	22
	Medium – evergreens 5 percent – 50 percent (< 5 percent pine)	80	52	47	49	00	00	47	00	39	00	51	65	54	51	00	34
84	Medium – deciduous, 1 or 2 species predominant	22	51	49	28	00	00	49	00	26	00	38	40	44	42	00	31
	Medium – deciduous, 3 or more species predominant	90	93	99	75	00	00	99	00	71	00	87	92	99	90	00	77
	Medium – mainly slash in cutover area	99	90	01	45	00	00	16	00	24	00	41	19	85	26	00	96
92	Heavy – conifers and other evergreens > 50 percent	29	55	07	40	00	00	01	00	46	00	67	38	39	42	00	42

Table 1 - Management condition index values.

Key Codes	Brief description	Quail	Rabbit	Squirrel-gray	Deer	Dove	Geese	Turkey	Field mice	Deer mice	Meadowlark	Mockingbird	Wood thrush	Fox	Raccoon	Kestrel	Black racer
93	Heavy - conifers and other evergreens < 50 percent	70	69	61	60	00	00	16	00	73	00	78	60	51	52	00	76
	Heavy - evergreens > 50 percent (< 5 percent pine)	26	64	15	56	00	00	12	00	59	00	73	49	43	52	00	59
	Heavy - evergreens < 50 percent (< 5 percent pine)	71	81	50	74	00	00	00	17	00	86	00	95	66	51	61	79
	Heavy - deciduous, 1 or 2 species predominant	23	62	50	53	00	00	16	00	53	00	28	63	41	53	00	52
	Heavy - deciduous, 3 or more species predominant	95	99	95	99	00	00	59	00	99	00	99	99	82	99	00	99
	Dominant tree composition [1] (3rd and 4th digits):																
03	2" - 6" DBH pines (> 5 percent)	05	99	01	16	94	00	01	00	05	00	82	01	19	04	01	01
63	2" - 6" DBH deciduous (> 95 percent)	05	79	20	67	13	00	20	00	23	00	99	25	28	14	05	20
04	> 6" DBH pines > 95 percent	15	01	07	01	99	00	05	00	01	00	01	05	01	01	19	02
14	> 6" DBH pines - 50-95 percent oaks, etc.	65	09	37	27	69	00	39	00	39	00	08	20	35	33	46	34
	> 6" DBH pines - 5-50 percent oaks, etc.	75	12	63	43	38	00	50	00	69	00	23	53	51	45	66	61

Table 1 - Management condition index values.

Key Codes	Brief description	Quail	Rabbit	Squirrel-gray	Deer	Dove	Geese	Turkey	Field mice	Deer mice	Meadowlark	Mockingbird	Wood thrush	Fox	Raccoon	Kestrel	Black racer
	> 6" DBH pines and maple gum	20	15	27	19	24	00	09	00	17	00	08	19	17	28	46	31
	> 6" DBH oaks and other upland species	80	20	99	99	05	00	99	00	99	00	17	81	92	86	99	99
	> 6" DBH maple gum predominant	10	11	29	38	01	00	12	00	09	00	08	28	25	45	35	27
	> 6" DBH bottomland, mixed species	90	78	74	95	08	00	69	00	45	00	13	99	99	99	90	78

1 Seedling size stand groupings considered dominantly herbaceous.

periods of the year. The categories of each major habitat type were evaluated assuming an optimum condition of the other types. Among the cropland types, quail might receive a high score of 99 for "soybean stubble in old grain stubble (no-till)" and a low score of 1 for "ground tilled with essentially bare earth remaining." Other components of the cropland type would be arrayed on an interval scale between 1 and 99. Each biologist was asked to consider the total range of use of a habitat component when assessing the relative score he assigned for a species.

The scores from such an evaluation could simply be averaged to summarize opinion. However, a simple average does not account for extreme variation in opinion. Knowledge of this variation can be used to isolate misinterpretations of habitat components or misunderstanding concerning the scoring procedure as well as account for divergent opinions in deriving a composite score.

The technique used for developing composite scores, which summarized the opinions of all biologists, first required the computation of a correlation matrix. These correlations show how well each biologist agreed with the others in the group and helped to identify misunderstanding in the application of the procedure. Anonymity was preserved so that in group discussions of an initial evaluation, each participant could adjust his scores with respect to group opinion without being pressured to agree if he chose to continue to disagree. The primary purpose of an intermediate committee discussion was to insure more uniform understanding of definitions and scoring procedures.

Correlations among biologists' scores were then used to determine the degree to which each biologist's opinion would be incorporated in the final score. This technique produces weights which are determined by the calculation of loadings on a principal axis in vector space (Gould and White (1974), [3] and Gould (1967). [4] Each weight assigned by the biologist is multiplied by his score for a particular habitat component. These are summed over all biologists to produce a weighted habitat score. After all habitat scores are computed, they are rescaled to the range of 1 to 99. This procedure was applied to derive weights for habitat components within each major land use type.

Each major land use was then similarly weighted. The product of major land use weight and each individual component weight produced the final weight for that land use habitat component.

Some land use categories for certain species were designated as not applicable due to total nonuse of that habitat component or

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3 P. Gould and R. White. 1974. Mental maps. Penquin Books, Inc., New York. 204 pp.

4 P. Gould. 1967. On the Geographic Interpretation of Eigenvalues Trans. Inst. British Geographers. 42:53-86.

insufficient use to warrant discussion.

Interspersion Evaluation. Interspersion of land uses was considered one of the key indications of value to many species including quail (Baxter and Wolfe 1972).[5] The random sample points were used to derive distance between land uses by measuring distances to formulate data which interpreted spatial distribution of land uses (habitat components) so that meaningful inferences could be drawn expressing habitat variances. Distance measurements were taken from each of the 60,000 points to the closest cropland, woodland, hedgerow (if woodland was not closer), herbaceous land area, residential site, and road. The mean of the distance from one land use to another was determined by measuring from each point to surrounding land uses and can be applied as an indicator of the interspersion for that land use.

The sensitivity of wildlife species to spatial relationships or interspersion of land uses was displayed in graphic form by plotting transformation curves. Blank graphs were distributed to participants with the request that they use personal knowledge and literature research to plot the effects of distance relations on each of the 16 species. Each of the major land use divisions was considered being in optimum condition for any species when constructing the curve. For any given major land use category there is a range of values which becomes difficult to comprehend. By considering the optimum condition, the work group took the best possible situation for the species and assigned it the highest value. Lower value management conditions lower the overall value through application of the equation. <u>The three major factors: quantity of land use, interspersion, and management condition are all interrelated in the framework of the developing mathematical model and none are valid if considered alone</u>. The relative importance of each of these three factors as interpreted by the work group is displayed in Table 2 for each species.

The transformation curves display the sensitivity of a species to interspersion. The mean distance was used as the index to interspersion. The curve is structured to visually display the effects of the mean condition on use of the habitat by a species. As the curve decreases from 1 to 0, it displays sensitivity, 1 meaning no sensitivity to distance or complete utilization and 0 meaning due to great sensitivity species has essentially no use of major land use type at the expressed distance (Figure 1).

The following distance relationships were chosen by the work group to apply in the analysis because of their demonstrated effects on

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5 W. L. Baxter and C. W. Wolfe. 1972. The Interspersion Index As a Technique for Evaluation of Bobwhite Quail Habitat. Nebraska Game and Park Commission, Lincoln. 11 pp.

Table 2 - Weights applied to management condition, quantity and interspersion relative to importance for each specie.

	Quail	Rabbit	Squirrel-gray	Deer	Dove	Geese	Turkey	Field mice	Deer mice	Meadowlark	Mockingbird	Wood thrush	Fox	Raccoon	Kestrel	Black racer
Management condition	33	36	44	34	50	41	41	52	53	49	46	46	39	36	42	47
Quantity	22	22	47	36	41	51	51	31	36	41	22	44	32	29	41	25
Interspersion	45	42	09	30	09	08	08	17	11	10	32	10	29	35	17	28

Figure 1 - Distance value transformation curves.

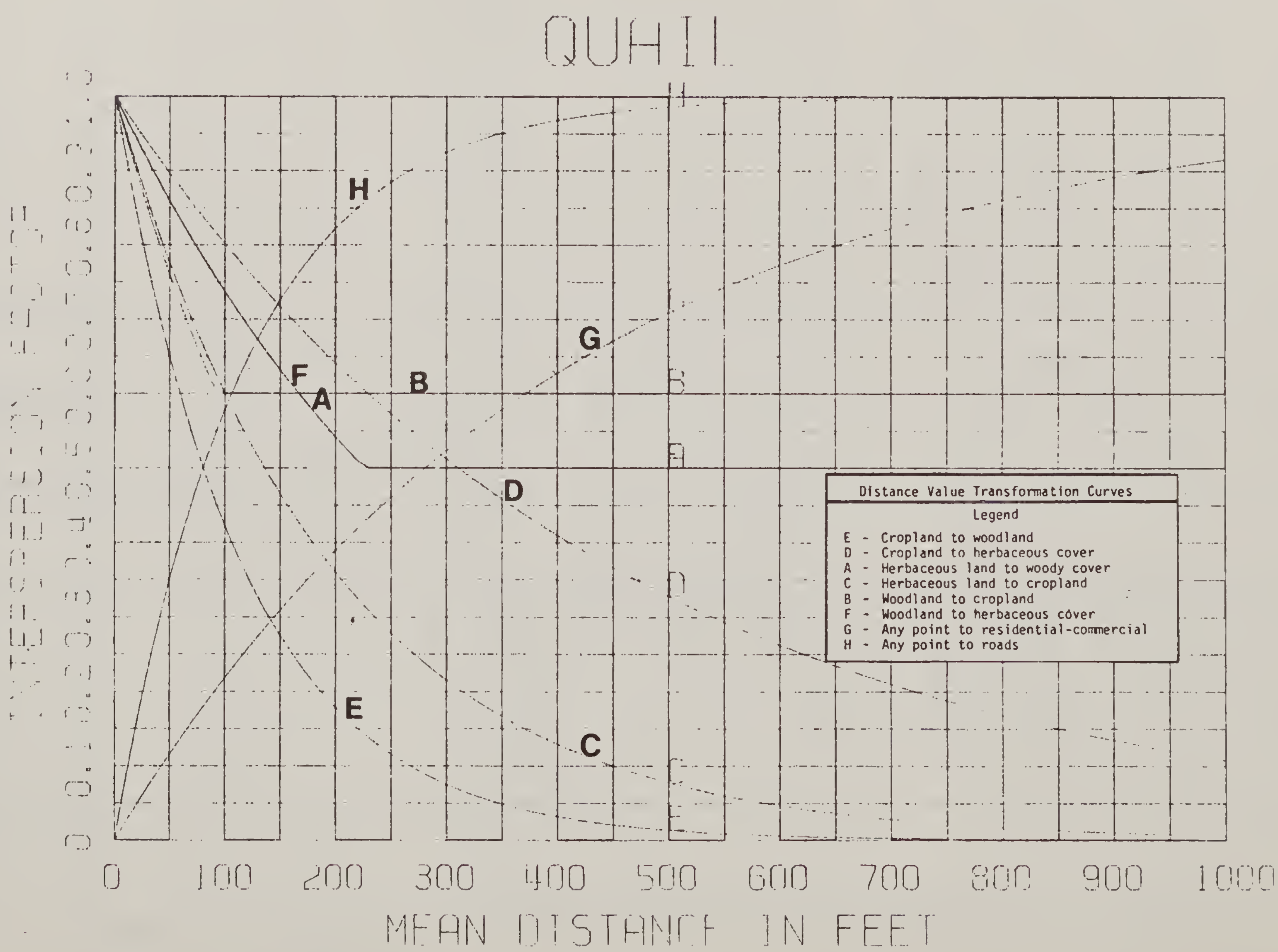


Figure 1 - Distance value transformation curves.

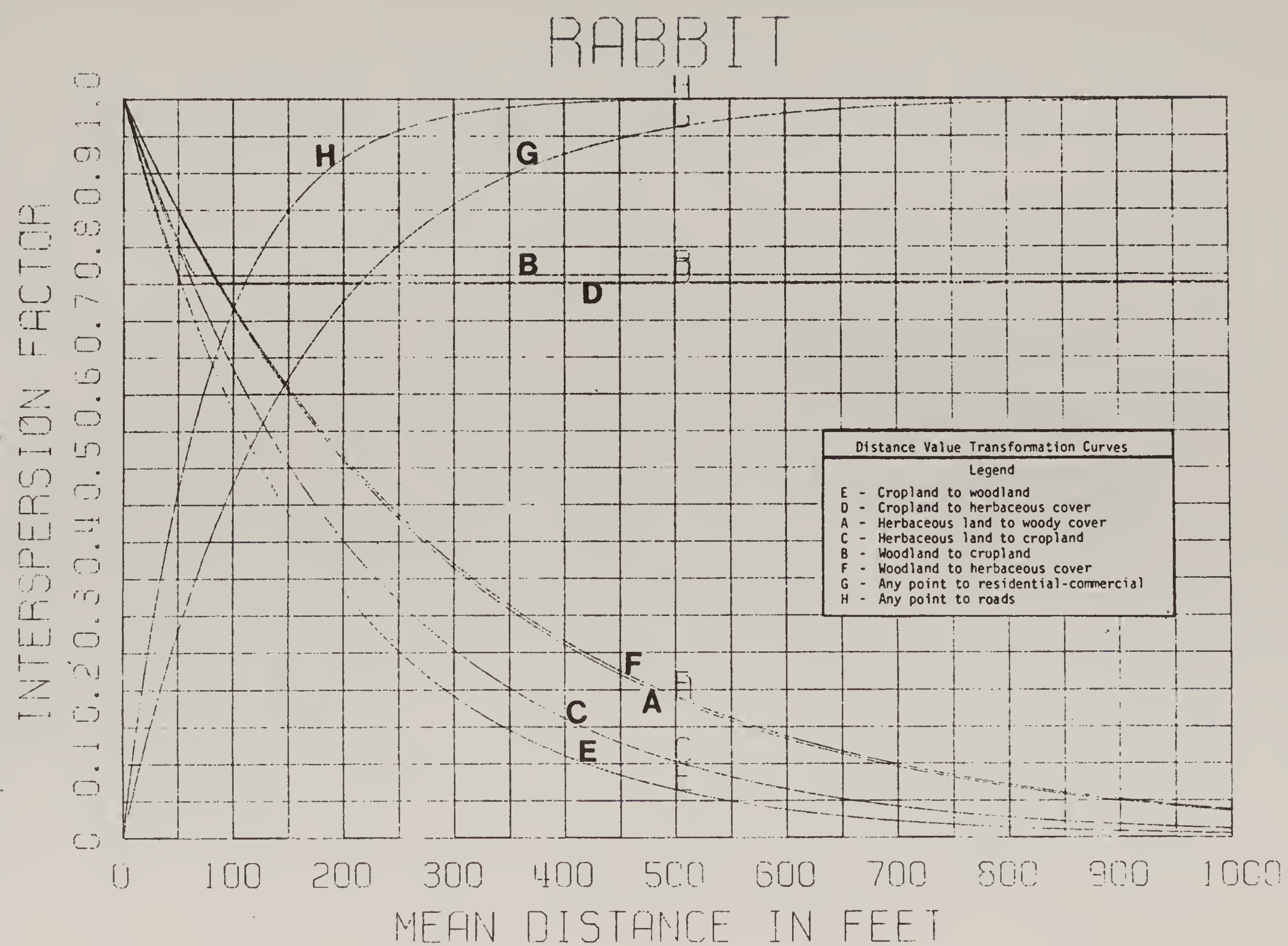


Figure 1 – Distance value transformation curves.

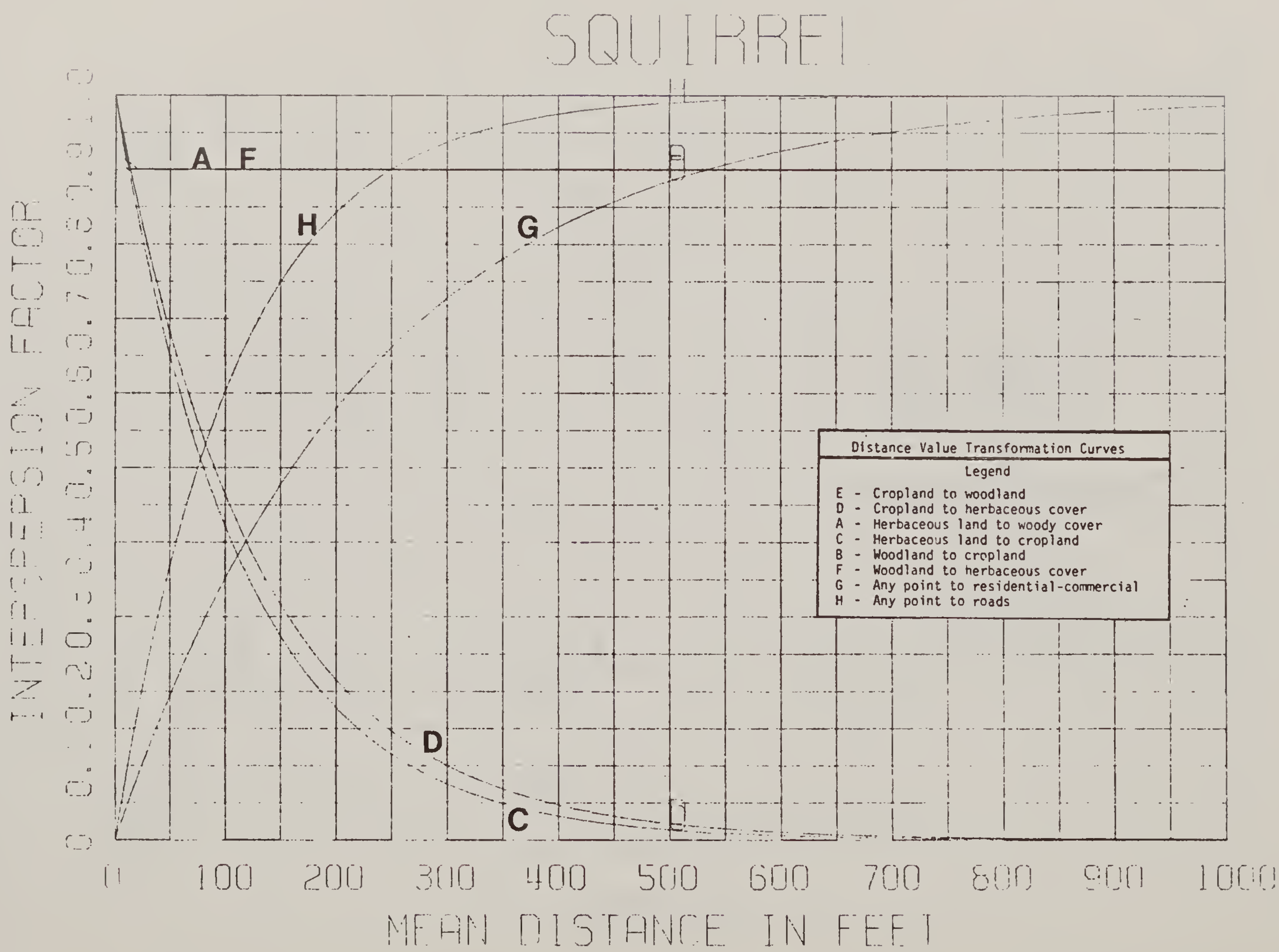


Figure 1 - Distance value transformation curves.

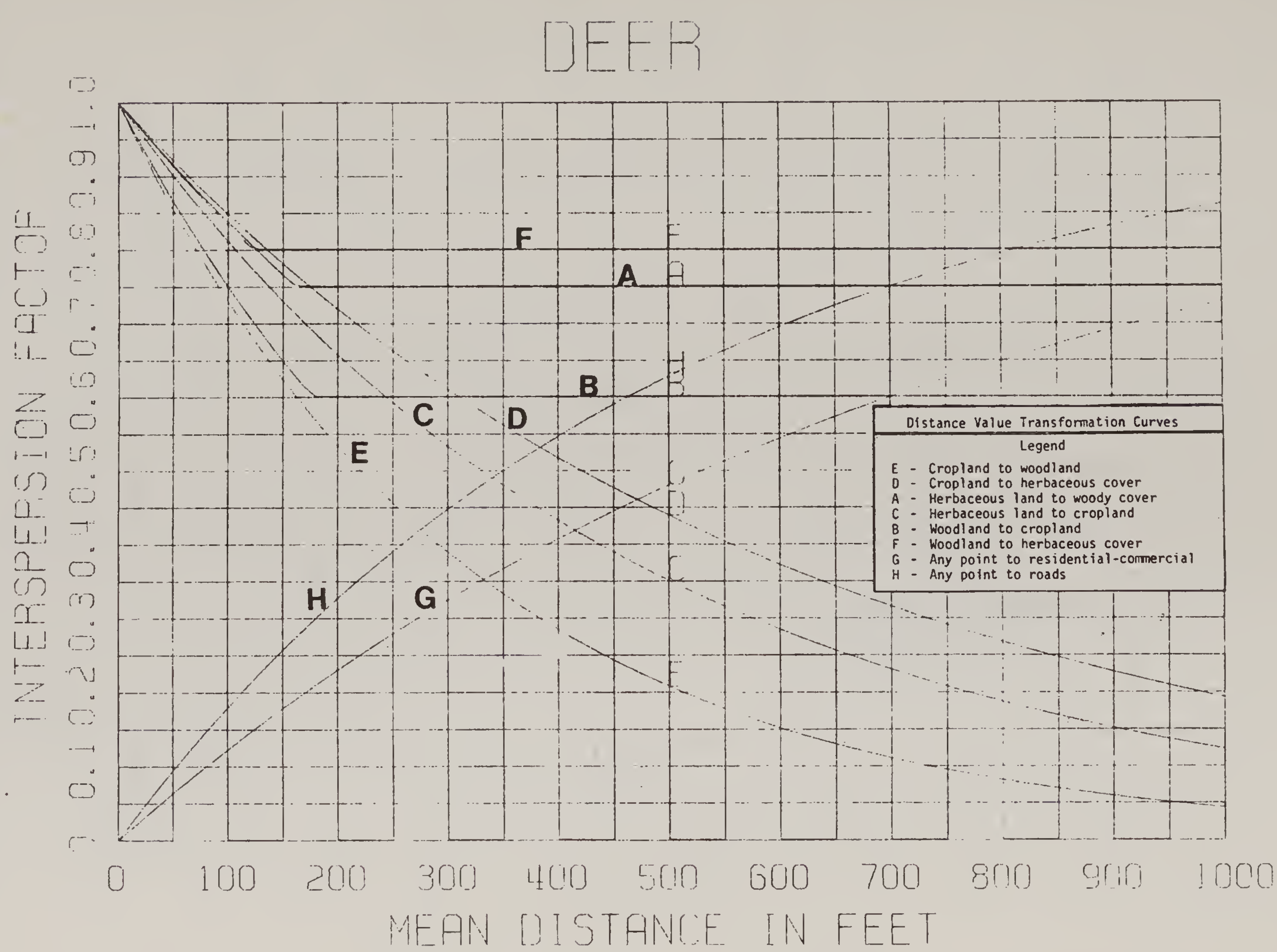


Figure 1 - Distance value transformation curves.

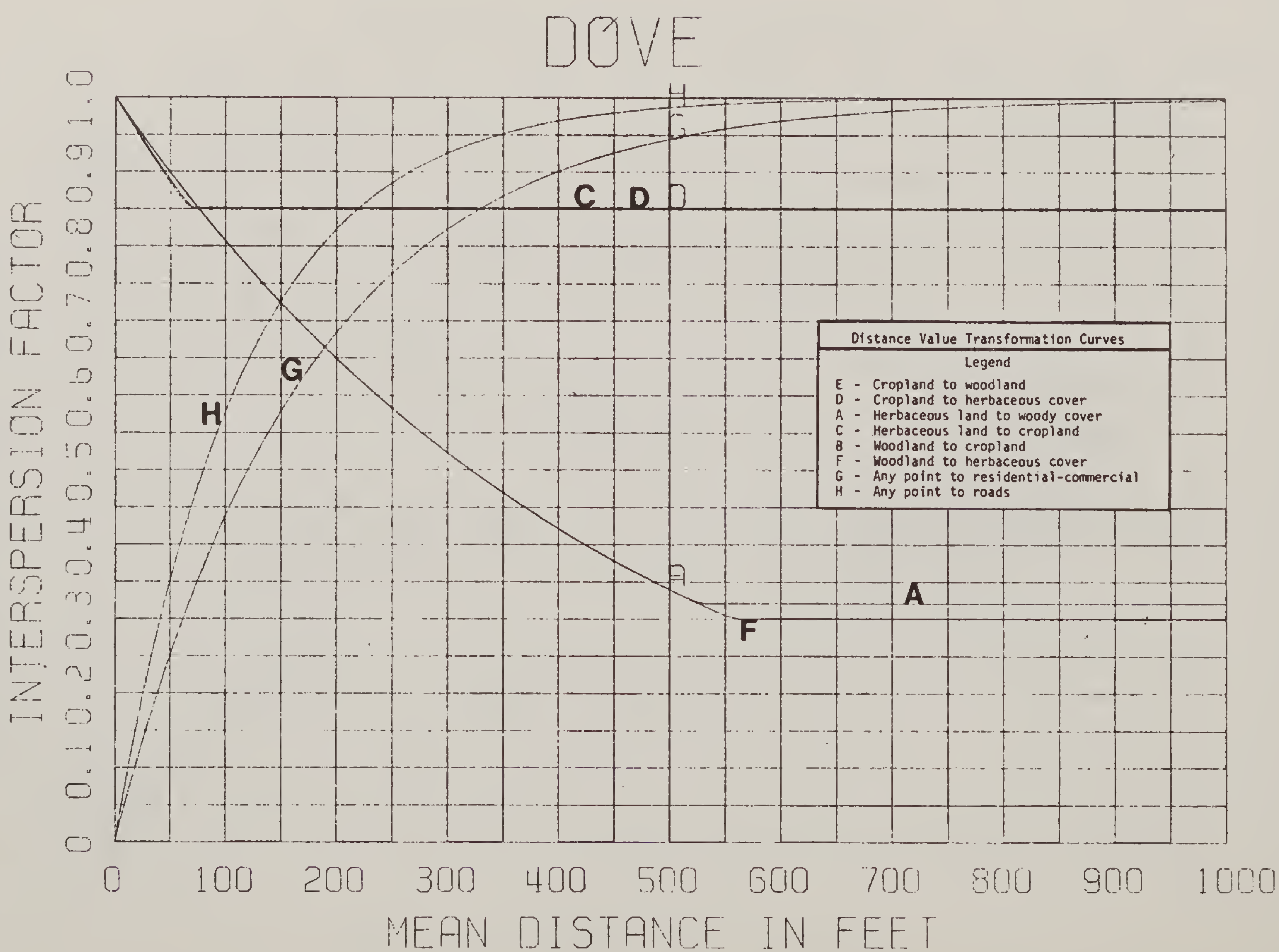


Figure 1 - Distance value transformation curves.

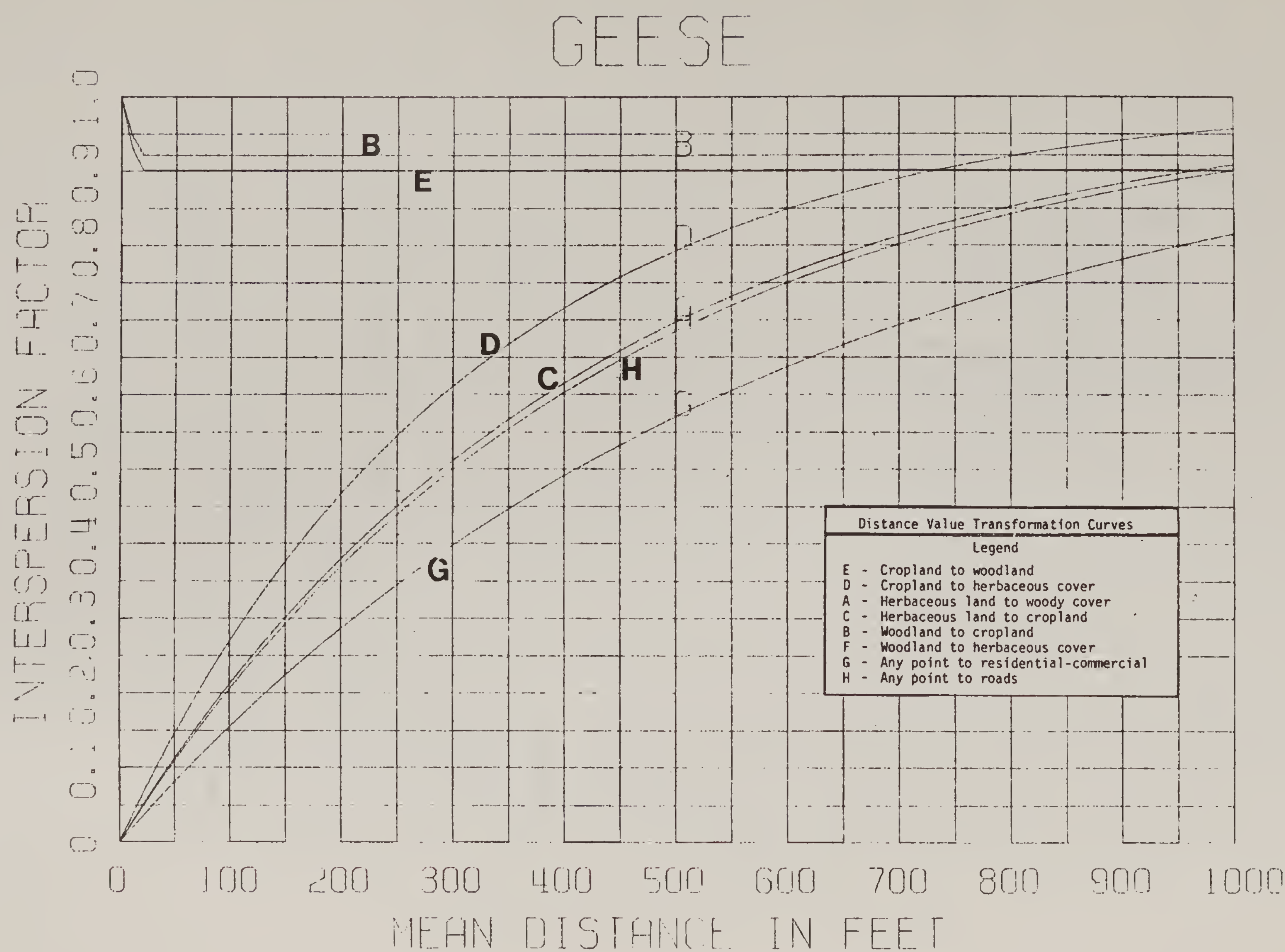


Figure 1 - Distance value transformation curves.

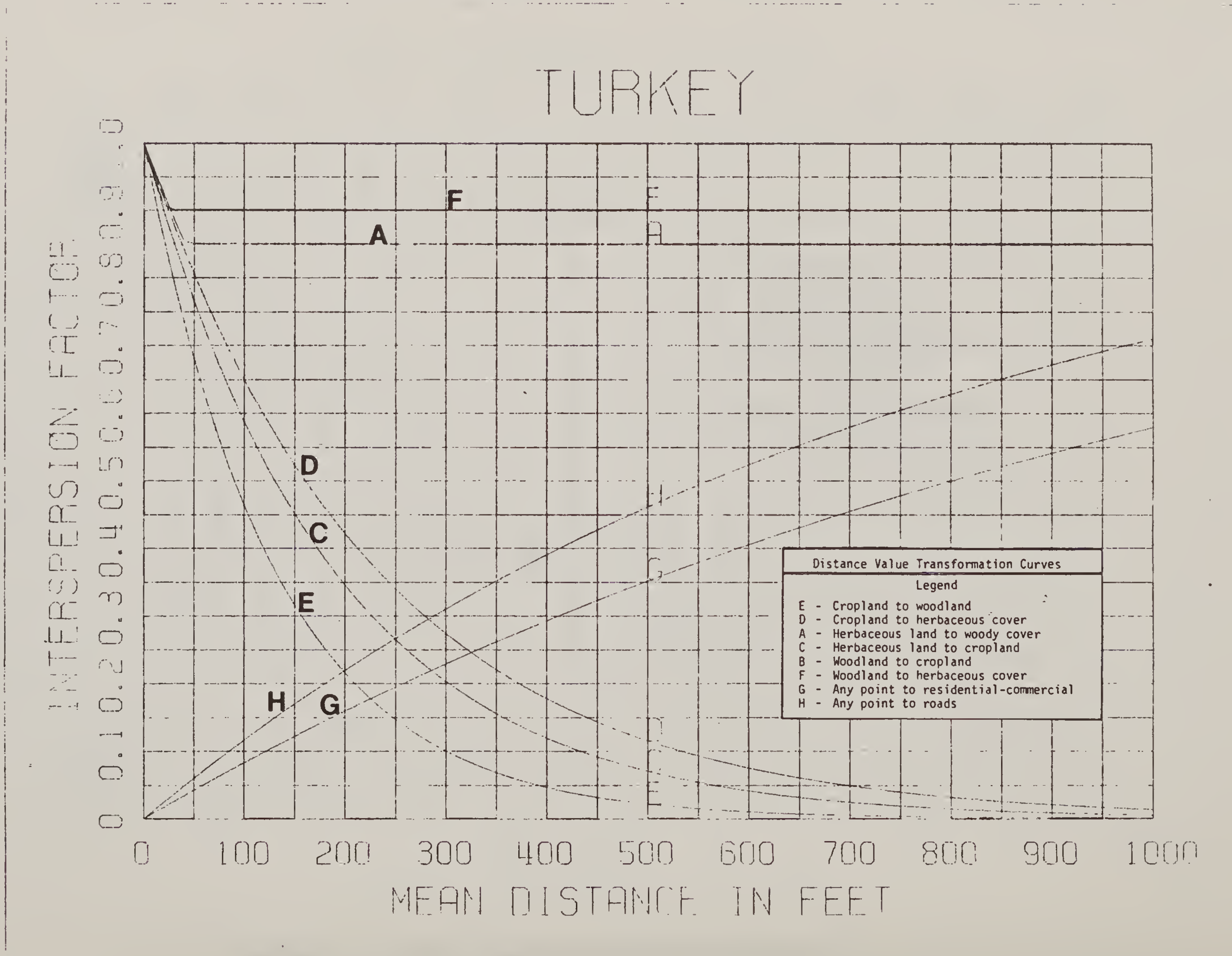


Figure 1 - Distance value transformation curves.

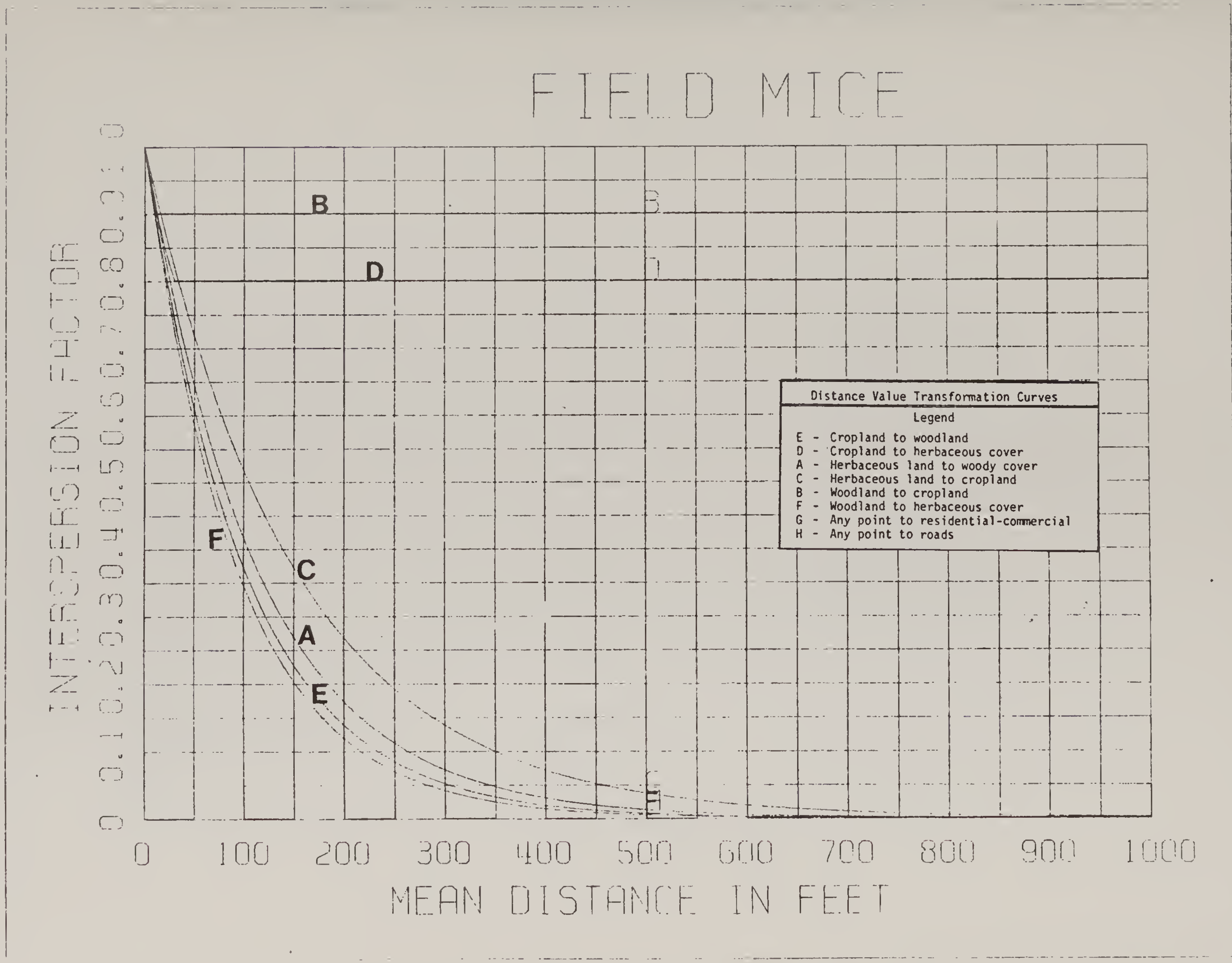


Figure 1 - Distance value transformation curves.

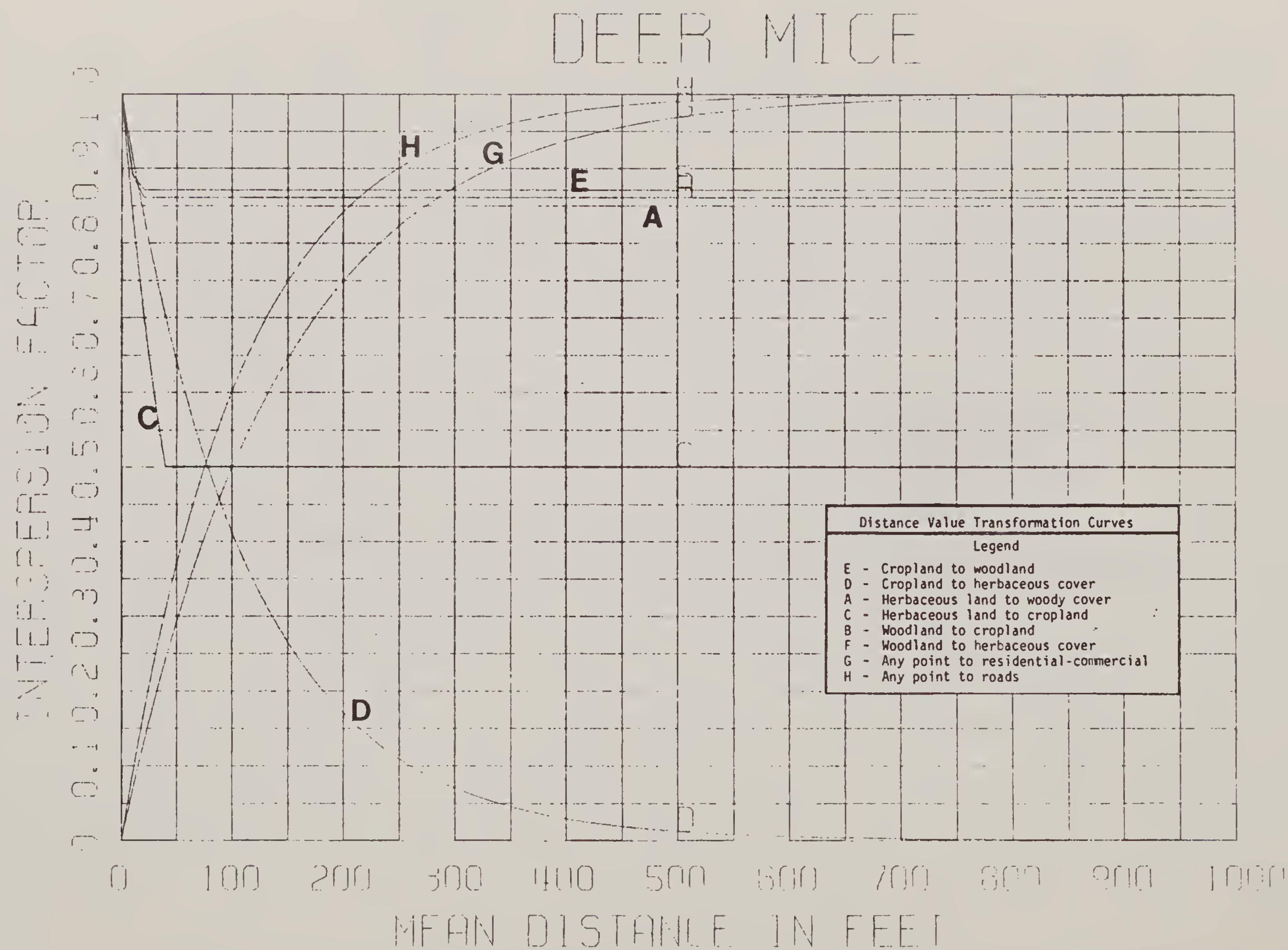


Figure 1 - Distance value transformation curves.

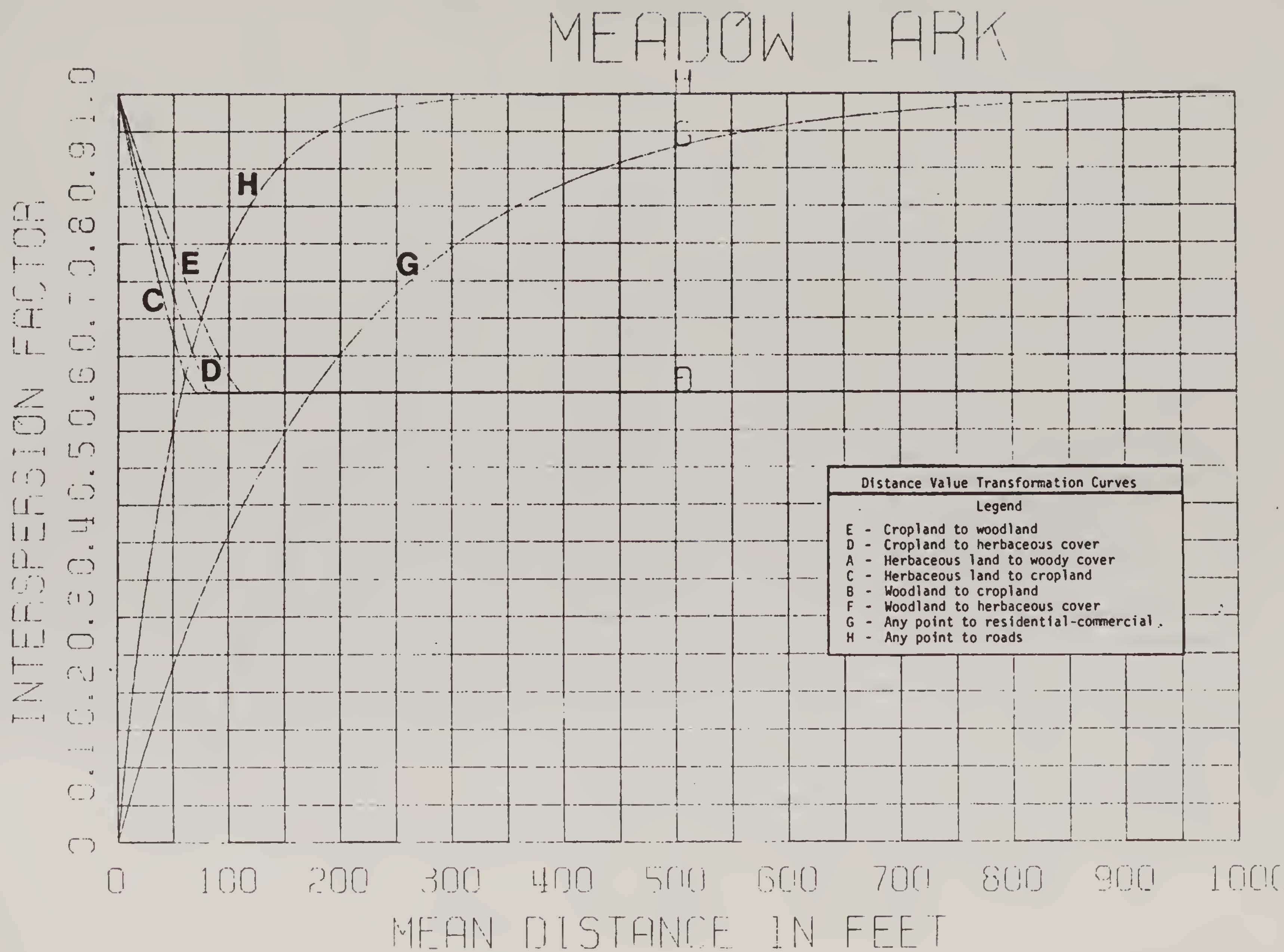


Figure 1 - Distance value transformation curves.

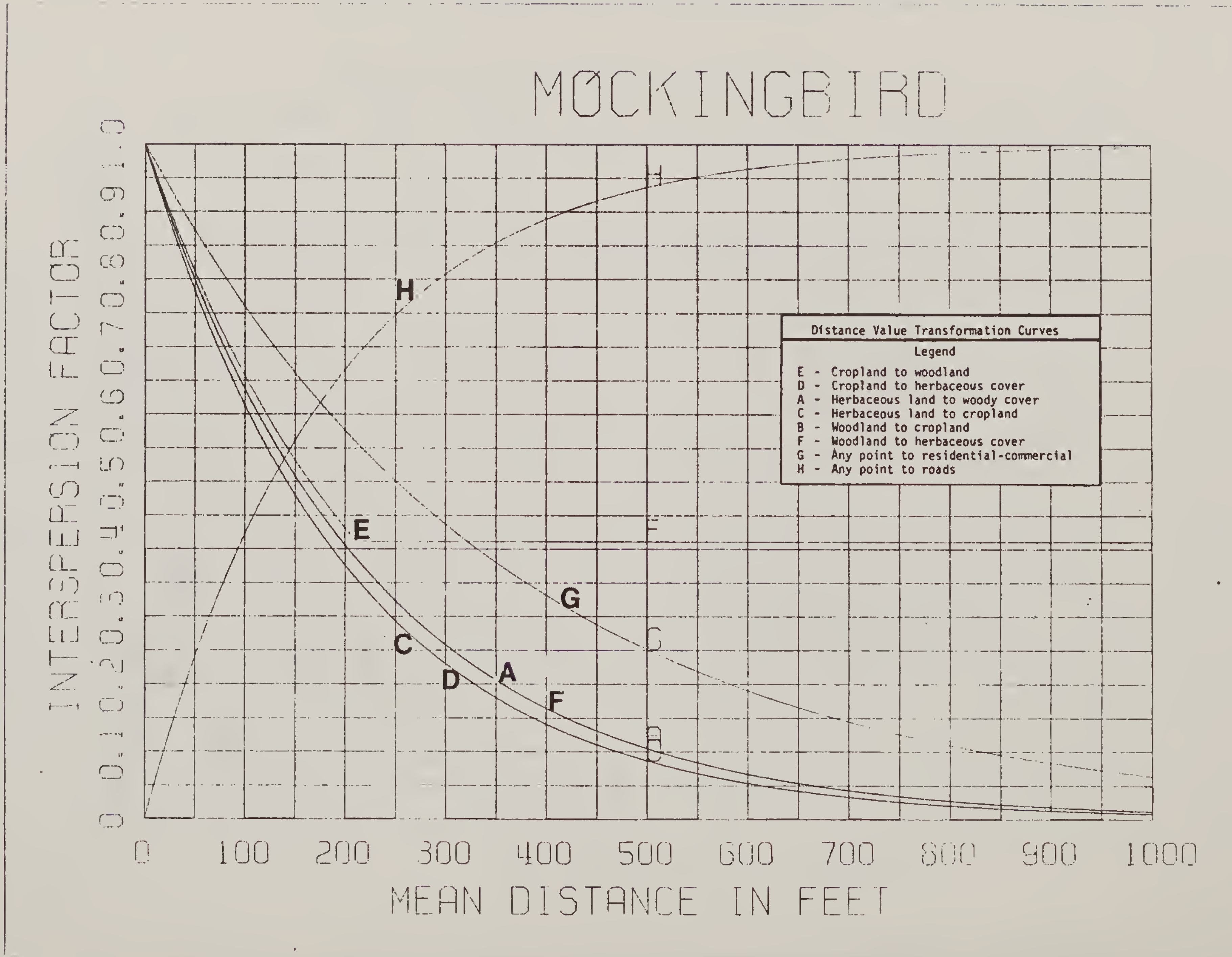


Figure 1 - Distance value transformation curves.

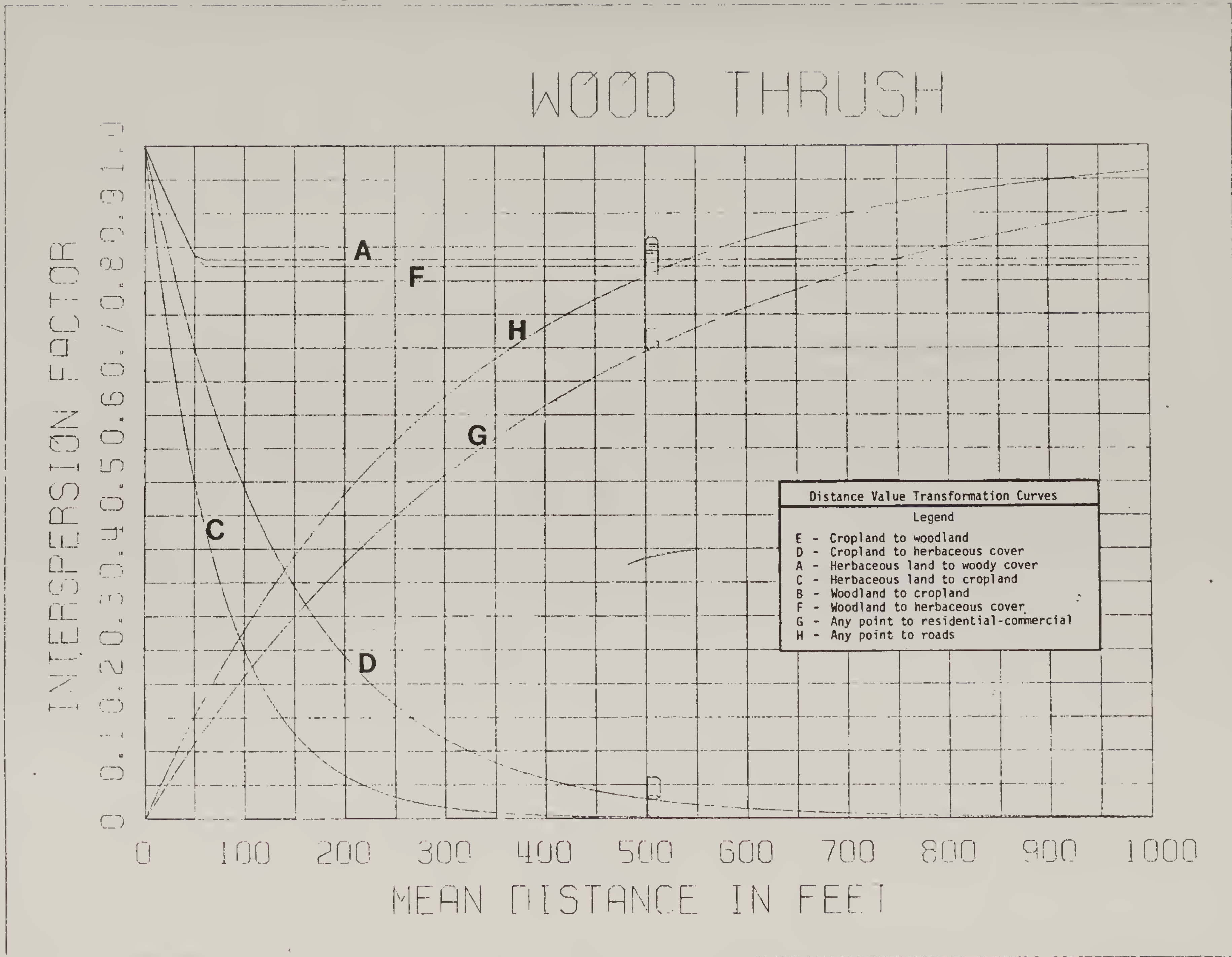


Figure 1 - Distance value transformation curves.

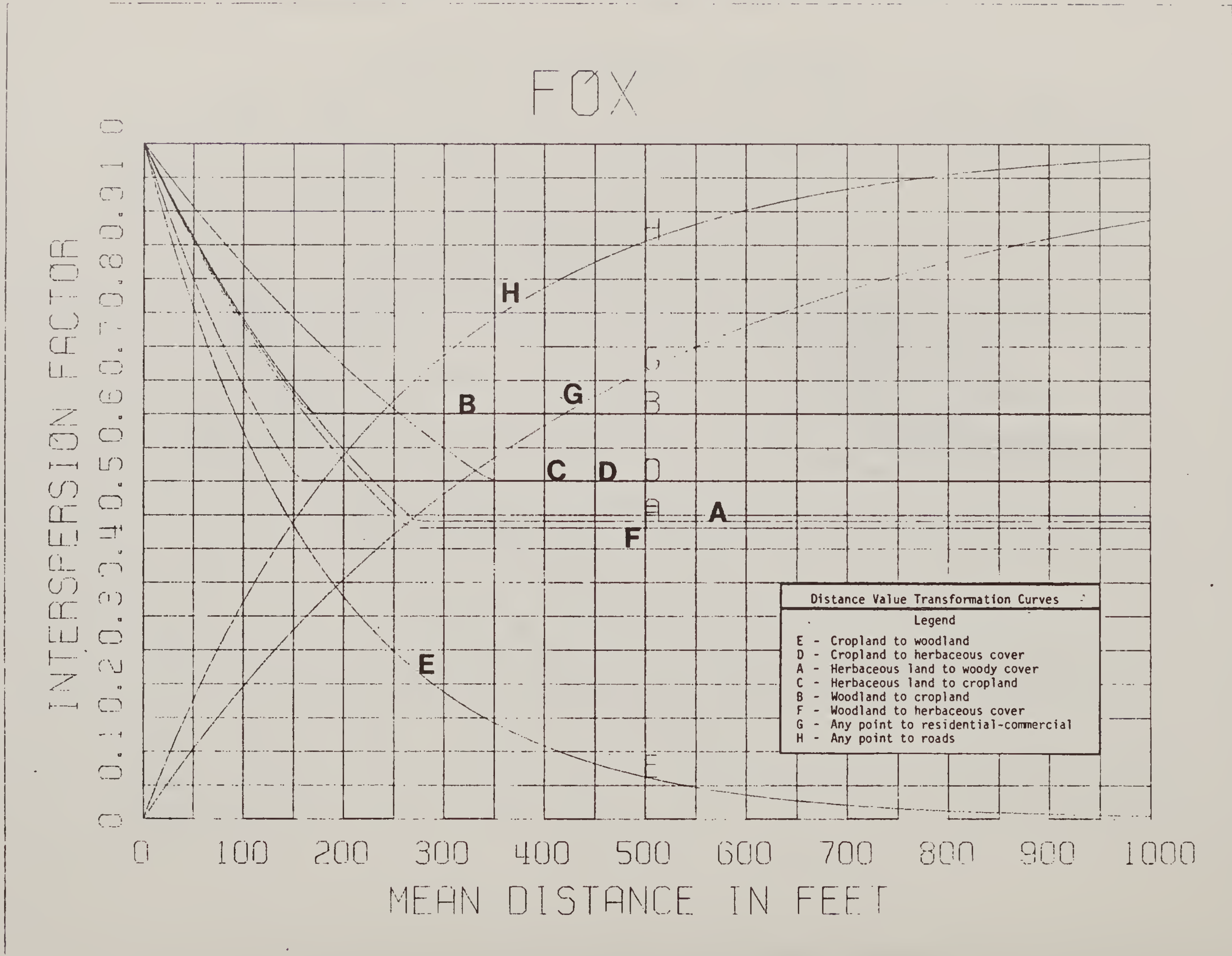


Figure 1 - Distance value transformation curves.

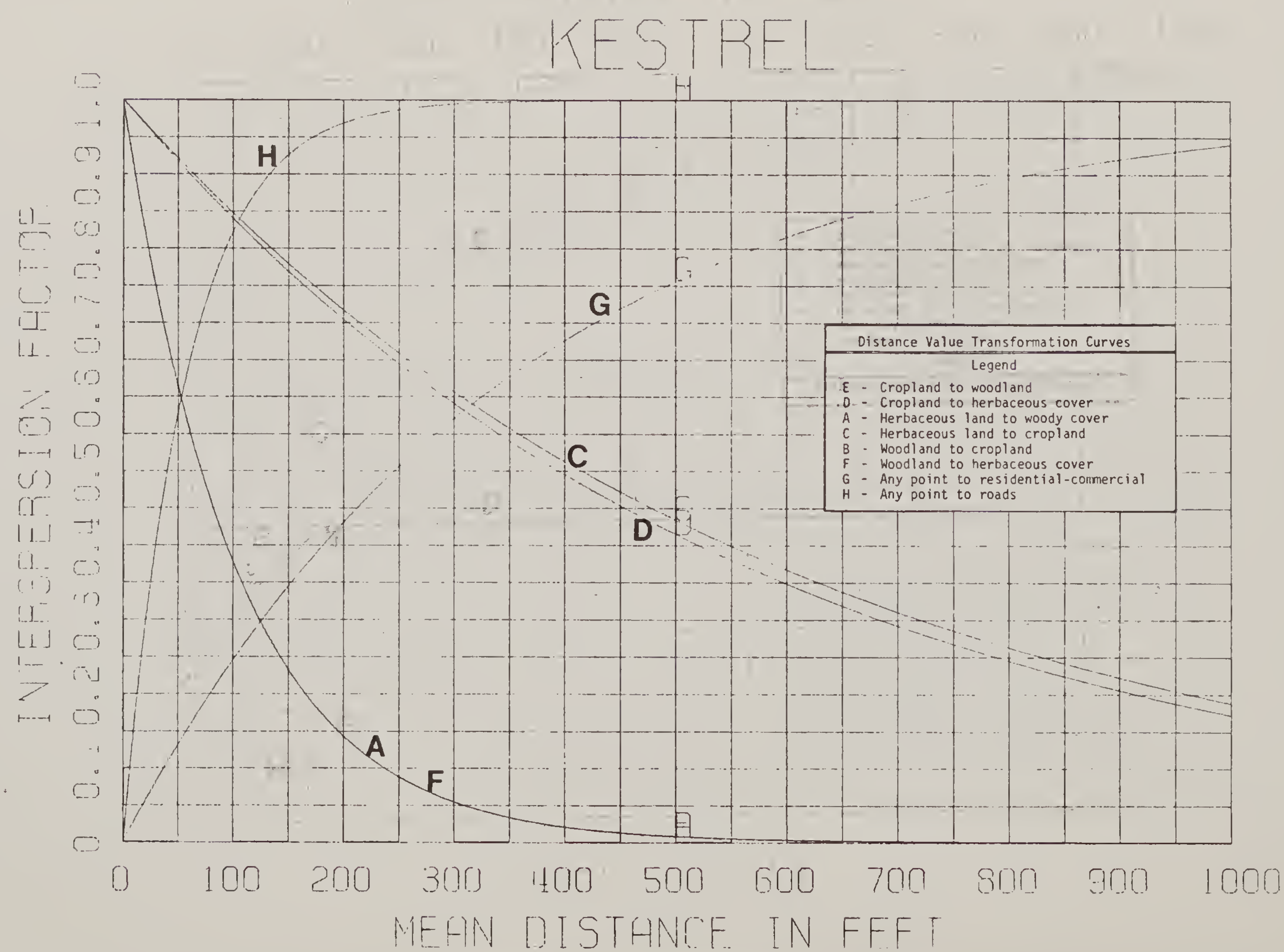
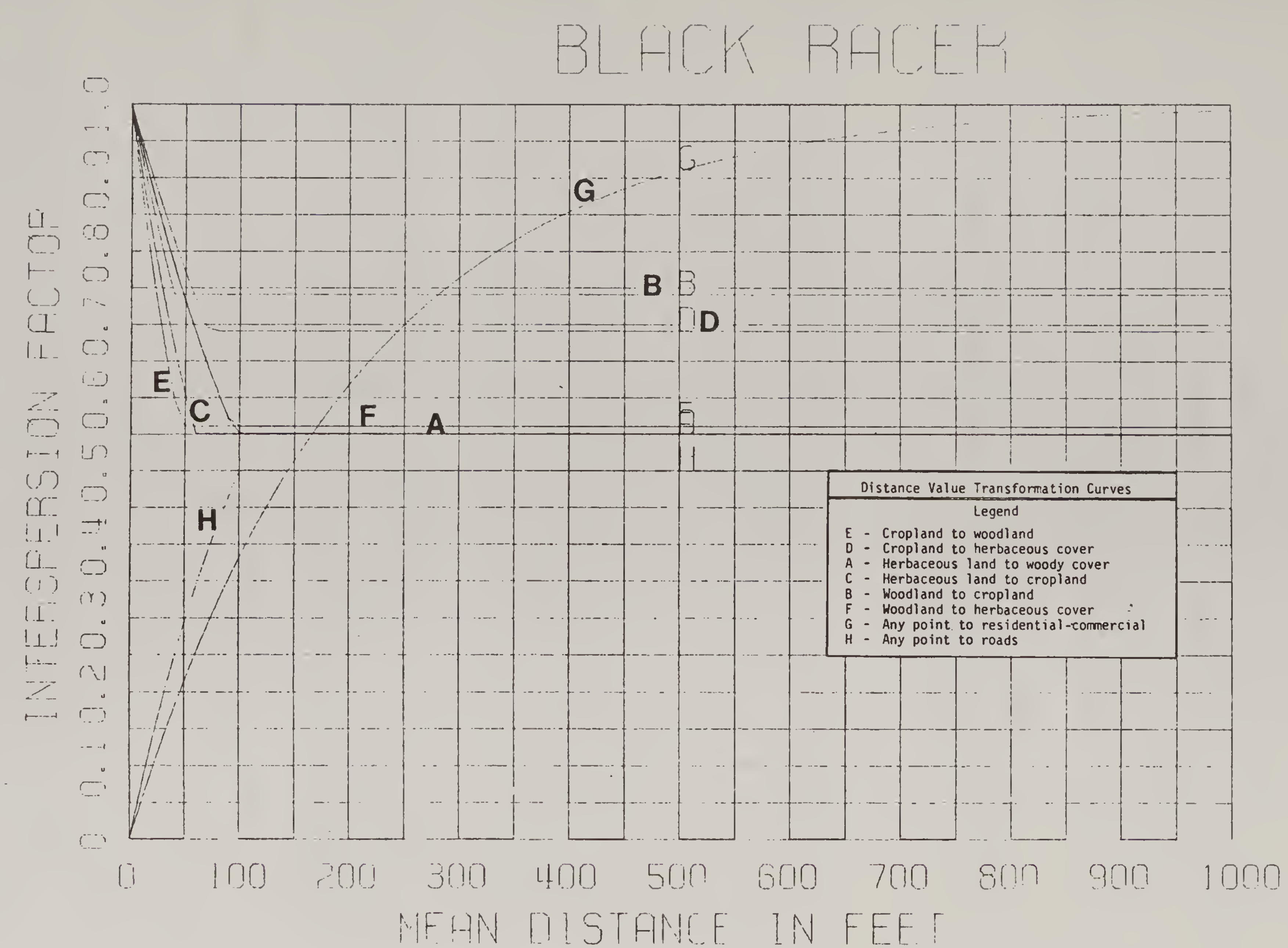


Figure 1 - Distance value transformation curves.



various species. The mean distances used are from:

1. Cropland to woody cover
2. Cropland to herbaceous cover
3. Herbaceous land to cropland
4. Herbaceous land to woody cover
5. Woodland to cropland
6. Woodland to herbaceous cover
7. Distance from any point to rural residential-commercial
8. Distance from any point to road

Conceptionally, the curves are structured displaying the distance a species will normally venture and utilize from land use Type A into land use Type B. This is displayed at the .5 value intersect. If the .5 value intersect had a corresponding distance measurement of 45.7 m and the mean measurement from land use Type A into land use Type B was also 45 m then one-half of the area would be utilized completely while the other half is unused. This same curve would be extended realizing that at 91.4 m only 25 percent of the area would be less than 45.7 m; and at 182.9 m only 12.5 percent would be less than 45.7 m; and at 365.8 m only 6.25 percent is being used. The upper construction of the curve would be designed to fit the species. Conceptionally, if the species would fully utilize 22.9 m out from land use A into B, the curve would be started at 22.9 m and proportionally develop it to meet the 45.7 m intersect.

For some species interspersion is not important and is displayed in a straight line. The line should decline showing a decrease in value if there is any benefit from an edge effect to the species. The declining line would signify that as the distance increases a smaller percentage of the land use type is adjacent to the edge.

A rabbit in an optimum herbaceous land unit has a slightly higher use along a woodland edge with a limited benefit interiorally to approximately 61 m. After the 61 m limit is reached, the use of the herbaceous area becomes equal and is plotted as a straight line slightly declining as the distance from herbaceous land to woodland becomes greater.

Each of these measurements has a weight relative in importance to the others that must sum to one which is equivalent to the total effect on any particular species. Some become nonapplicable while others are equal in their display and can be expressed jointly by one curve. Some distance measurements seem to have no effect on a species and therefore

were not plotted.

Quantity Land Use Curves. Some species such as gray squirrels, require a certain amount of a particular land use type and do not require additional diversity of other types. Other species such as white-tailed deer, may utilize a more diverse habitat; deer can survive in woodland but benefit from the existence of cropland and herbaceous land. The assumption is made that for any particular species there is an ideal condition where each land use becomes proportional for theoretical optimum habitat of that species.

The work group determined that to reflect the effect of land use quantities on the quality of habitat, curves would have to be structured showing the relative quantities of the following five land uses:

1. Cropland

2. Herbaceous land

3. Rural residential-commercial

4. Water dominated areas

5. Woodland

These quantities should have an optimum level of existence for each species. The limitation of the survey is 6,070 ha. The range of the percentage land use is expressed on the graph with this in mind. On the graph the percentage of land use signifies to the interpretor the relative value expressed as a coefficient from 0 to 1. A scaled coefficient near 1 indicates an ideal quantity of a specific land use and a value near 0 indicates an inadequate quantity of a land use. Knowing that for certain species one land use can substitute for others, it is possible to have various situations of percentages of land uses with similar values. Within some curves plateaus are structured showing little to no variance of value to the range of land use percentages. Some species do not require curve developments for water or wetlands due to a lack of importance for that species (Figure 2). Other species possess relative values for various land uses compared to other land uses (Table 3).

DISCUSSION

The Delmarva Wildlife Work Group refined a procedure for comprehensible and sound development of collection and analysis of data. The data was collected over 19,425 km^2 at 60,000 sites. Involvement of over 150 participants led to wide acceptance and use of the procedure. Computerized retrieval of data led to increased use of data due to a minimal time requirement for extraction of information.

Figure 2 - Quantity factor - land use value transformation curve for Quail

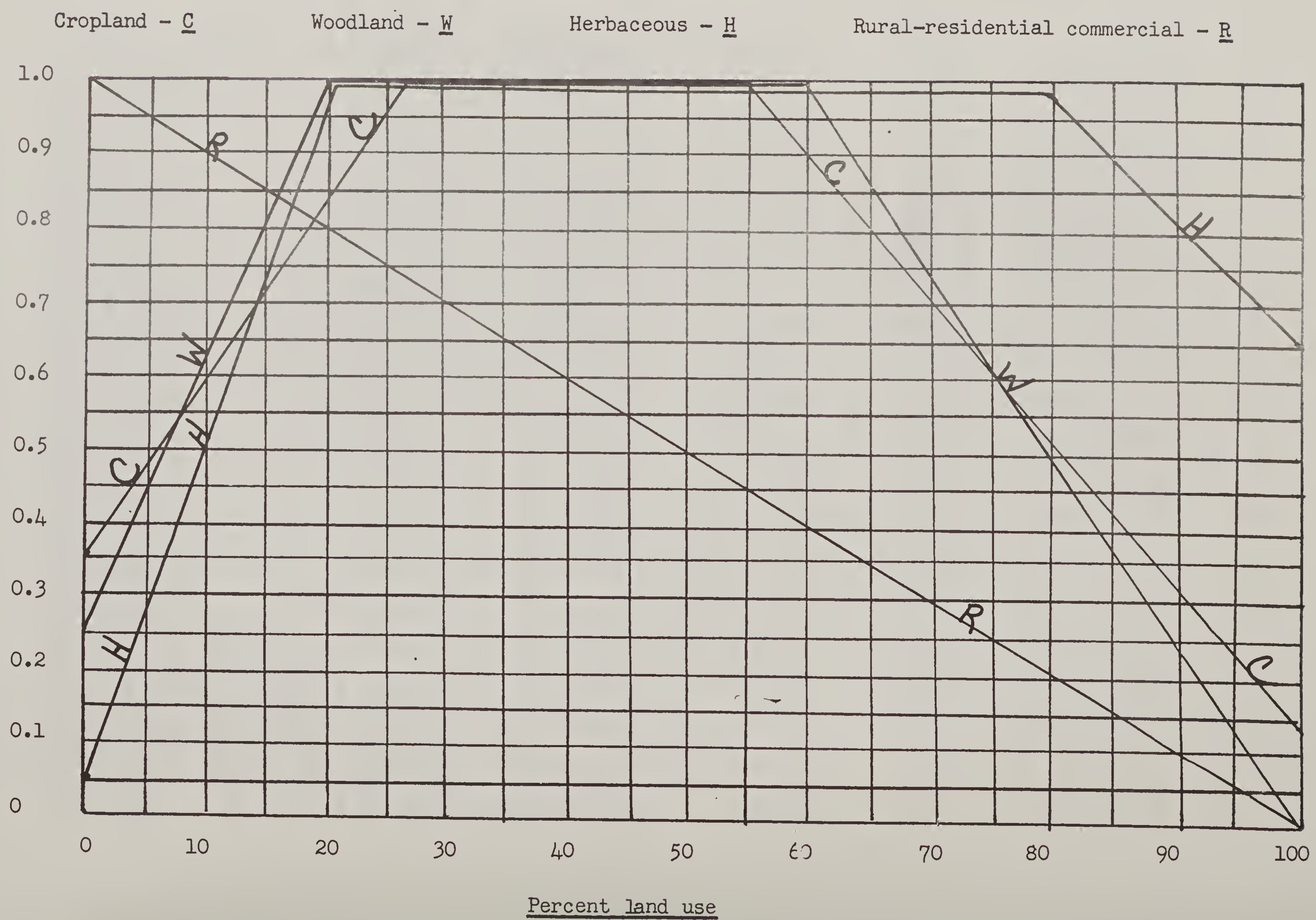


Figure 2 - Quantity factor - land use value transformation curve for

Rabbit

Cropland - C   Woodland - W   Herbaceous - H   Rural-residential commercial - R

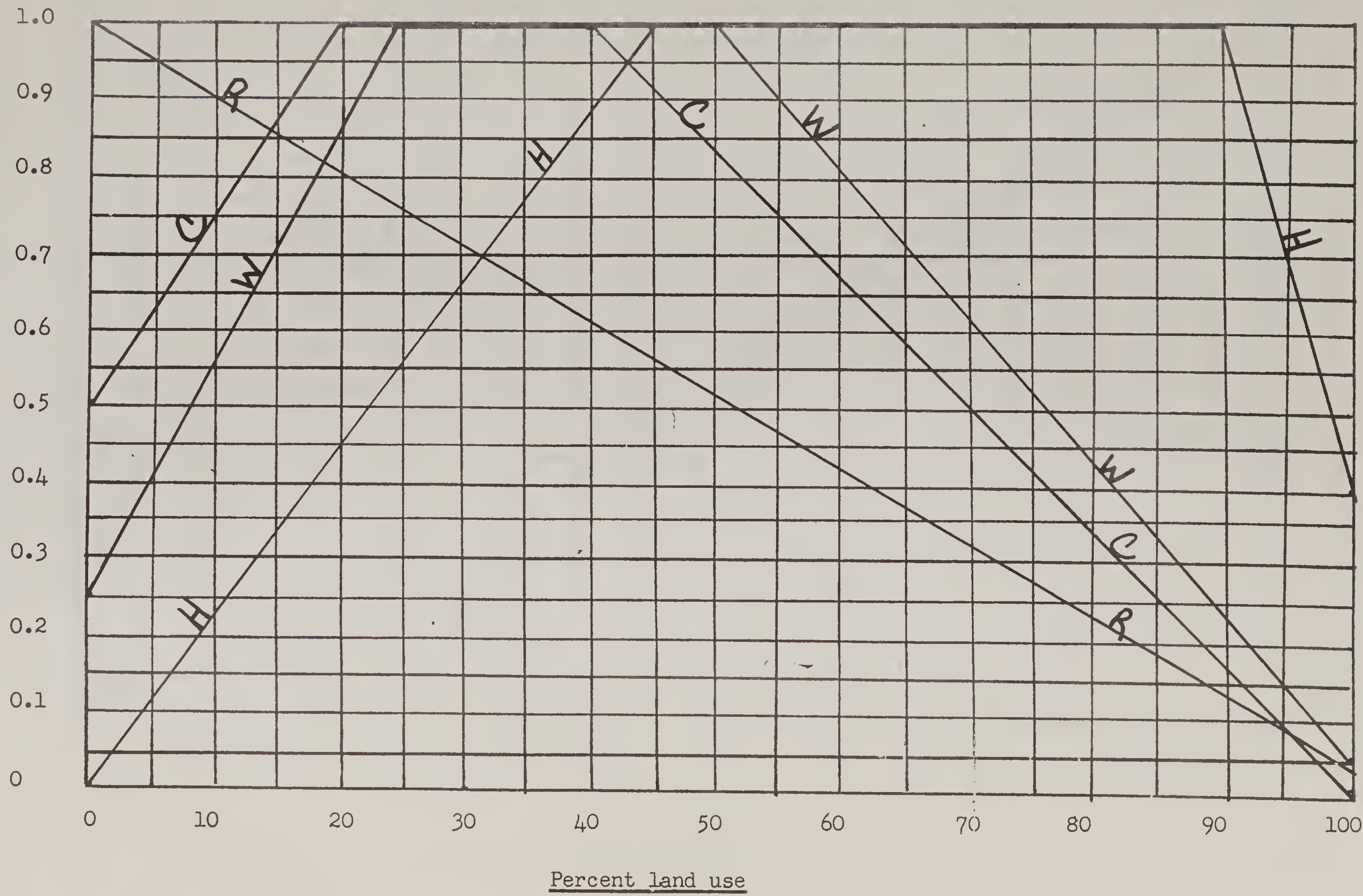


Figure 2 - Quantity factor - land use value transformation curve for

Gray Squirrel

Cropland - C Woodland - W Herbaceous - H Rural-residential commercial - R

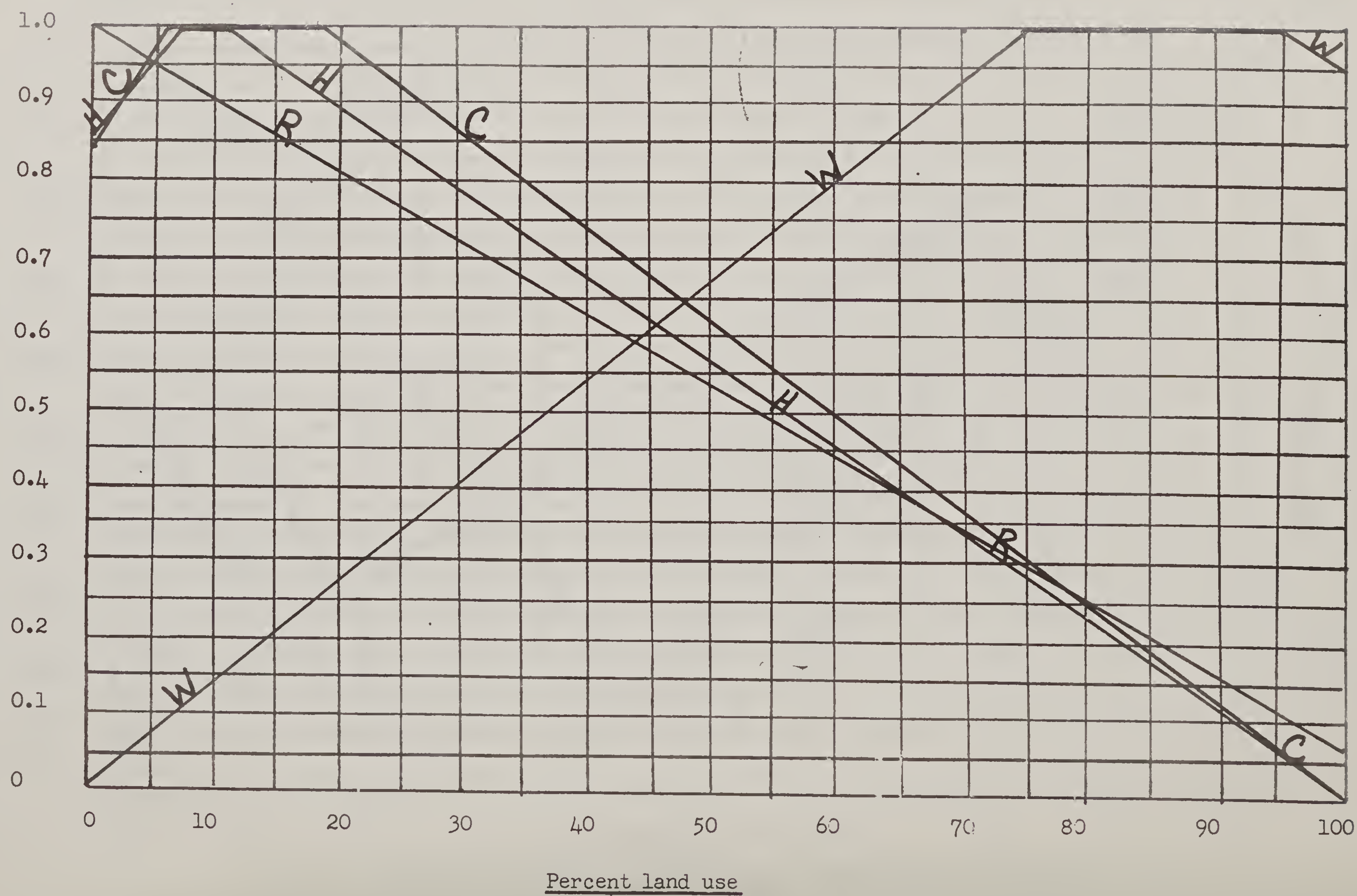


Figure 2 - Quantity factor - land use value transformation curve for

Deer

Cropland - C   Woodland - W   Herbaceous - H   Rural-residential commercial - R

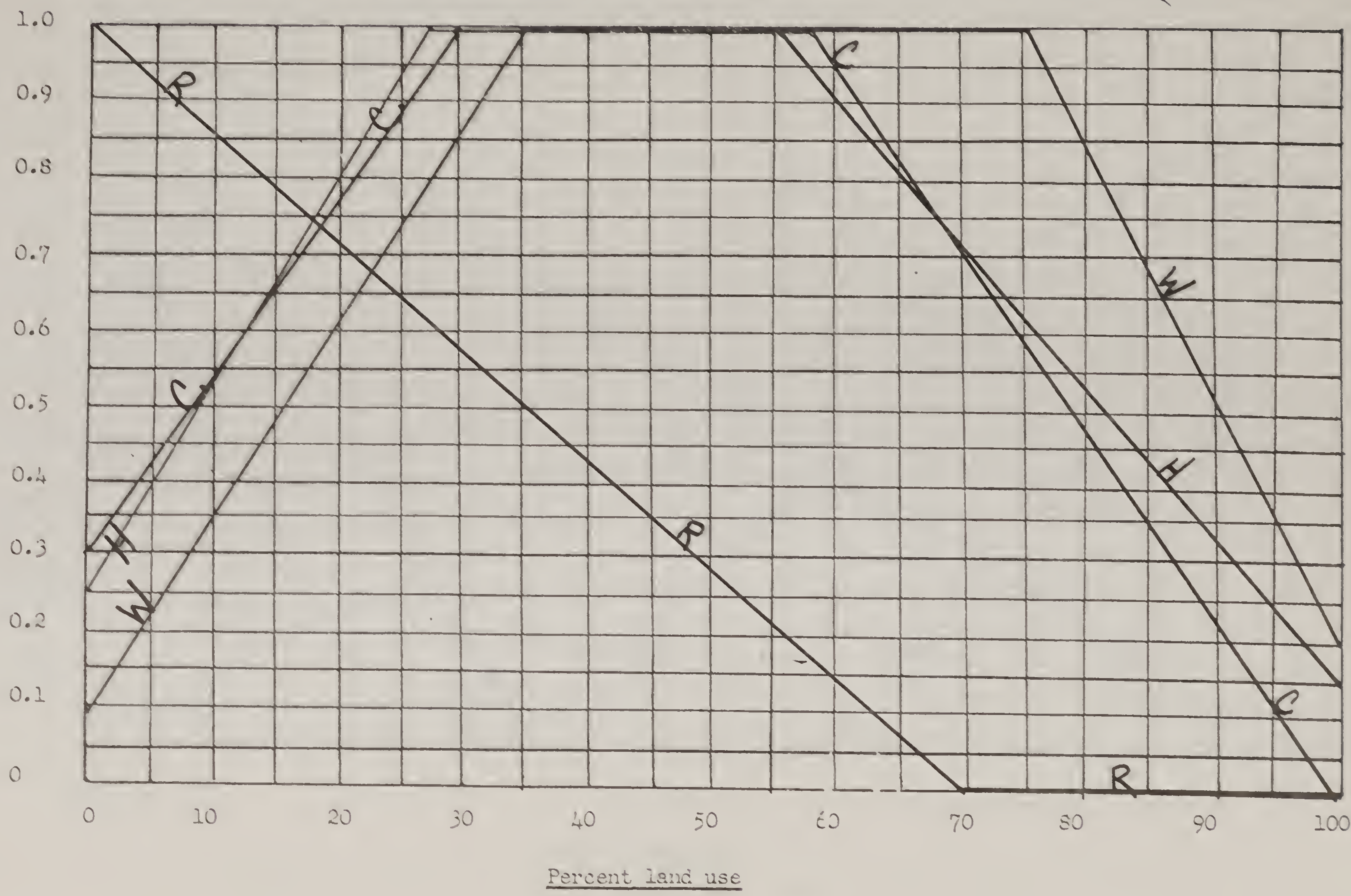


Figure 2 - Quantity factor - land use value transformation curve for

Dove

Cropland - C   Woodland - W   Herbaceous - H   Rural-residential commercial - R

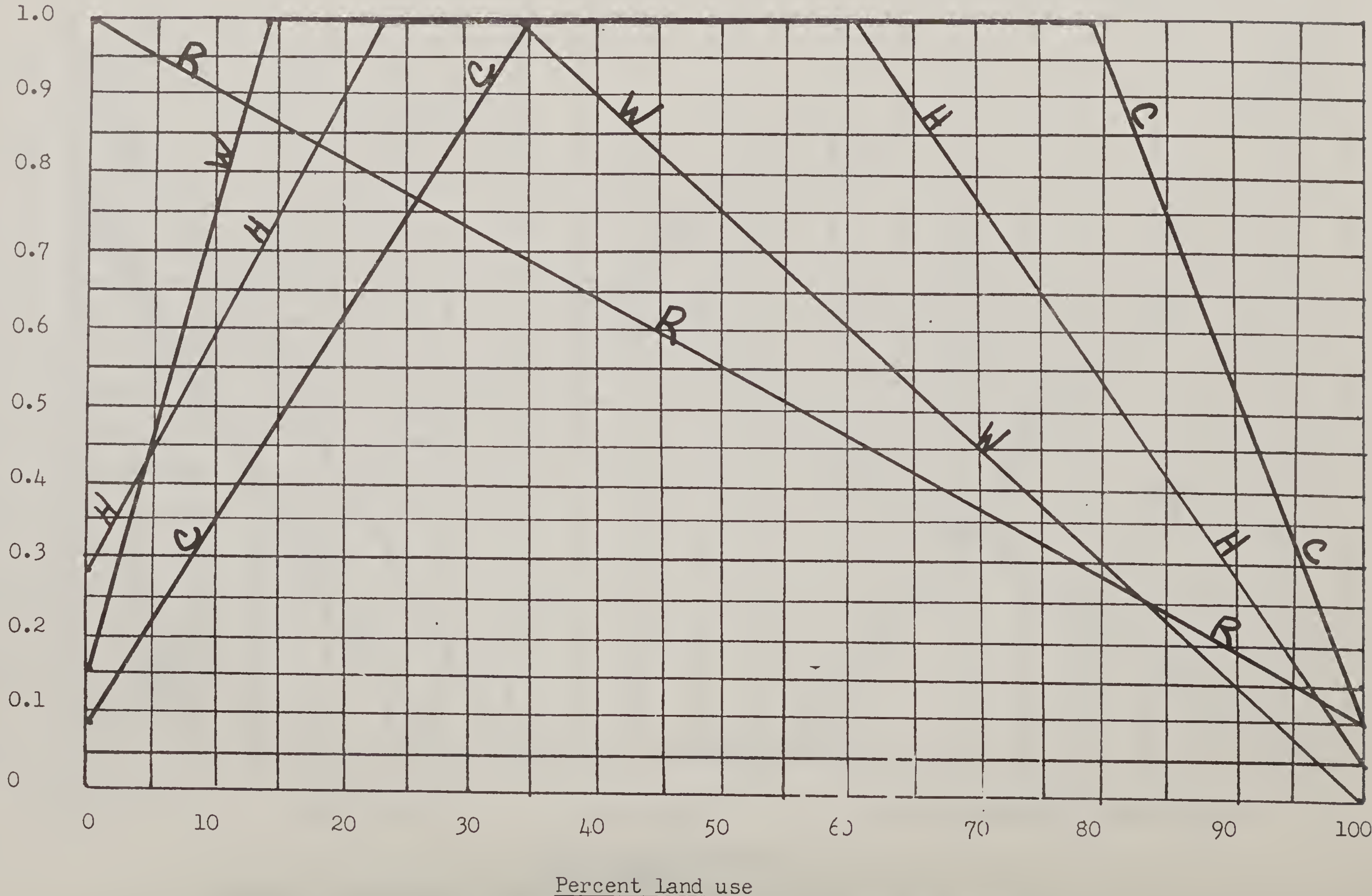


Figure 2 - Quantity factor - land use value transformation curve for

Geese

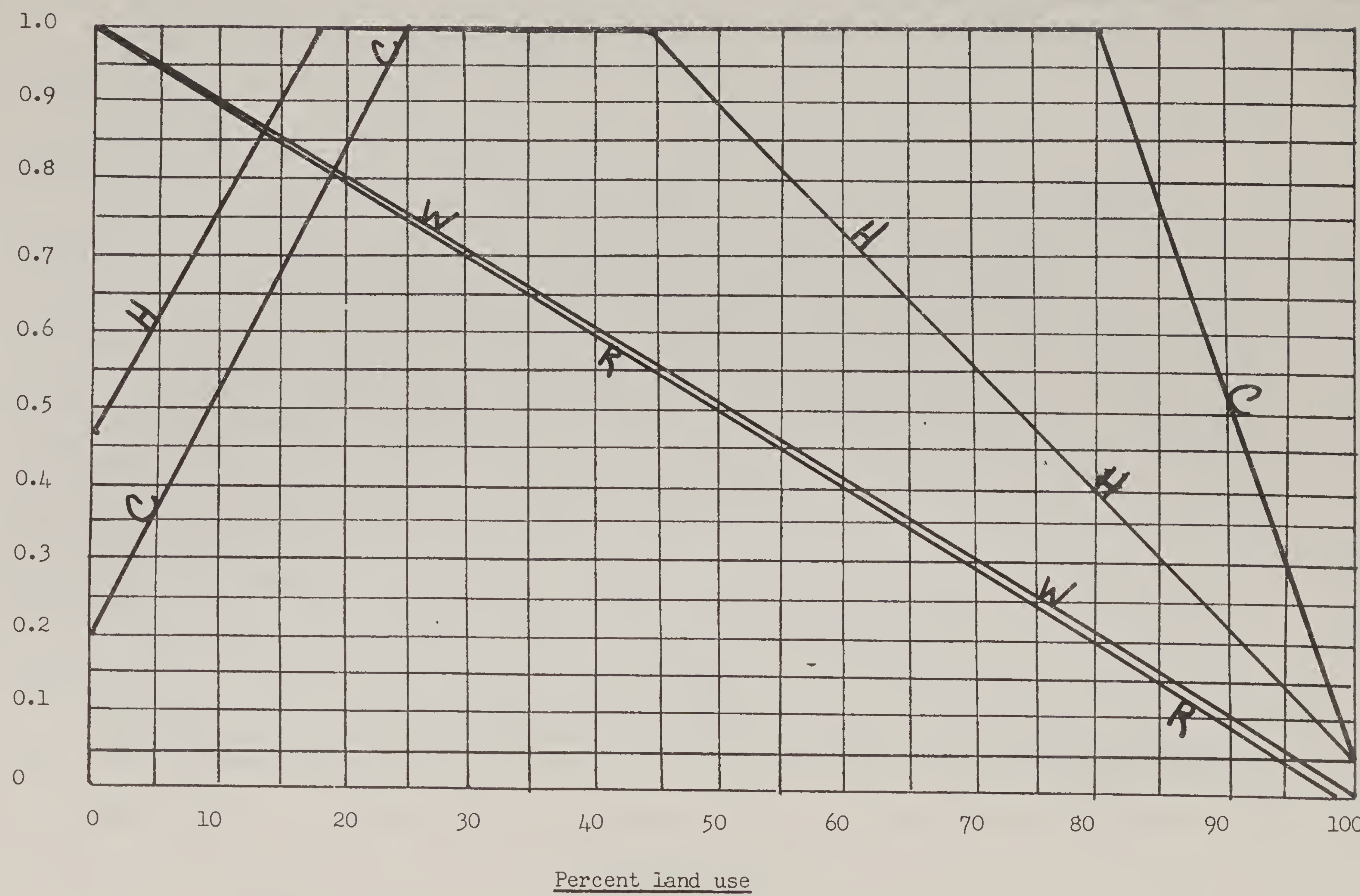


Figure 2 - Quantity factor - land use value transformation curve for Turkey

Cropland - C Woodland - W Herbaceous - H Rural-residential commercial - R

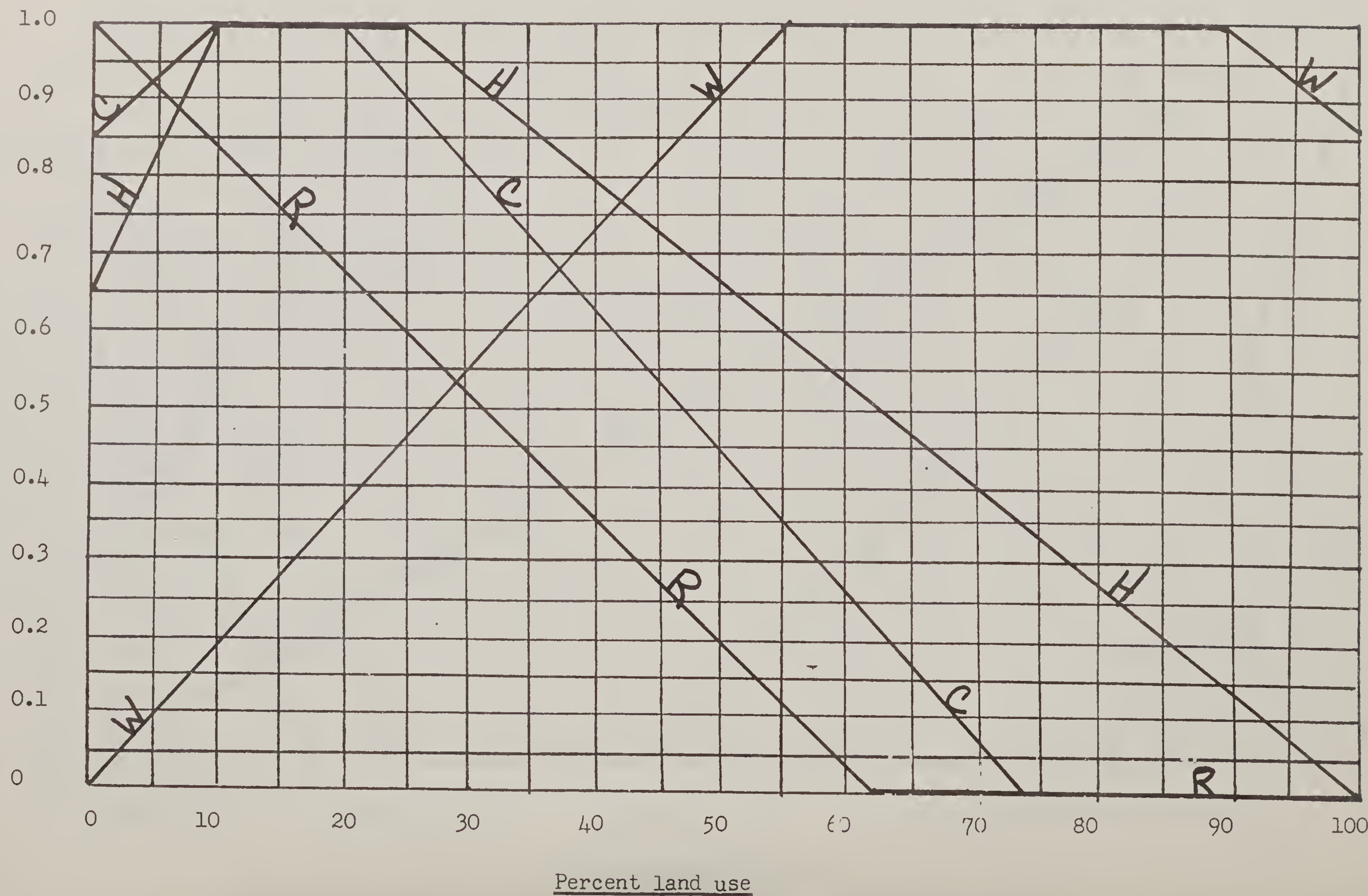


Figure 2 - Quantity factor - land use value transformation curve for

Field Mice

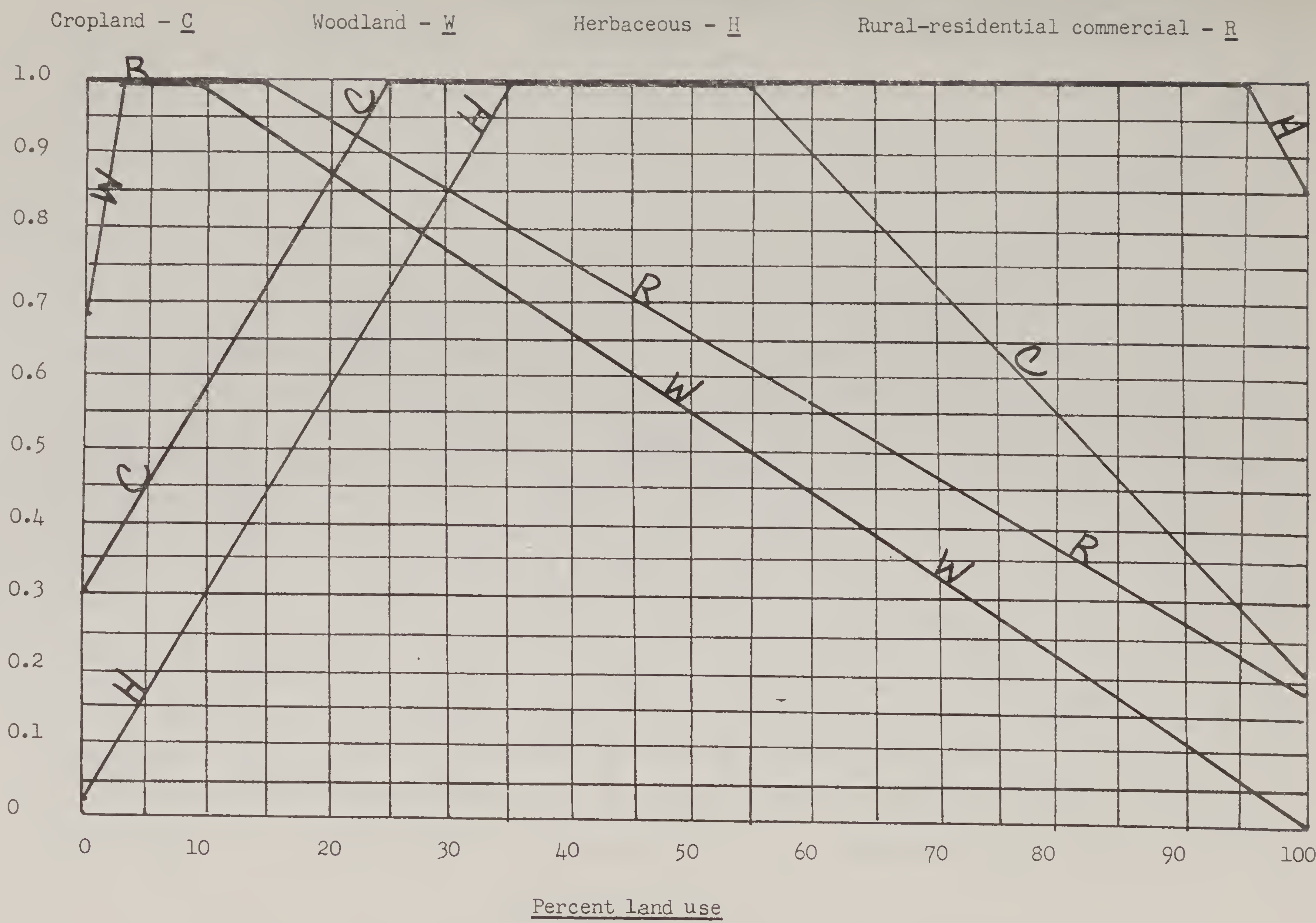


Figure 2 - Quantity factor - land use value transformation curve for

Deer Mice

Cropland - C   Woodland - W   Herbaceous - H   Rural-residential commercial - R

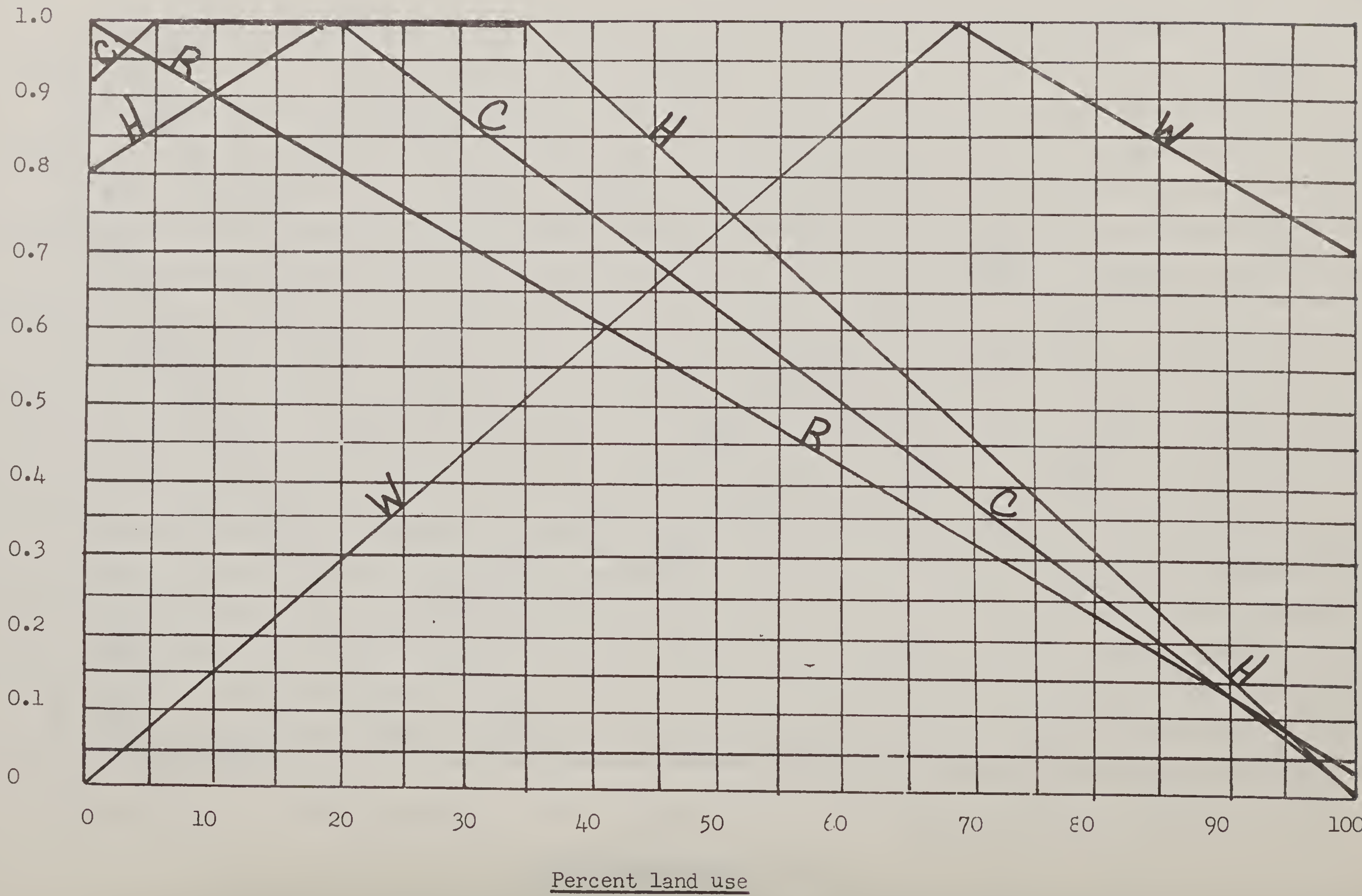


Figure 2 - Quantity factor - land use value transformation curve for

Meadowlark

Cropland - C Woodland - W Herbaceous - H Rural-residential commercial - R

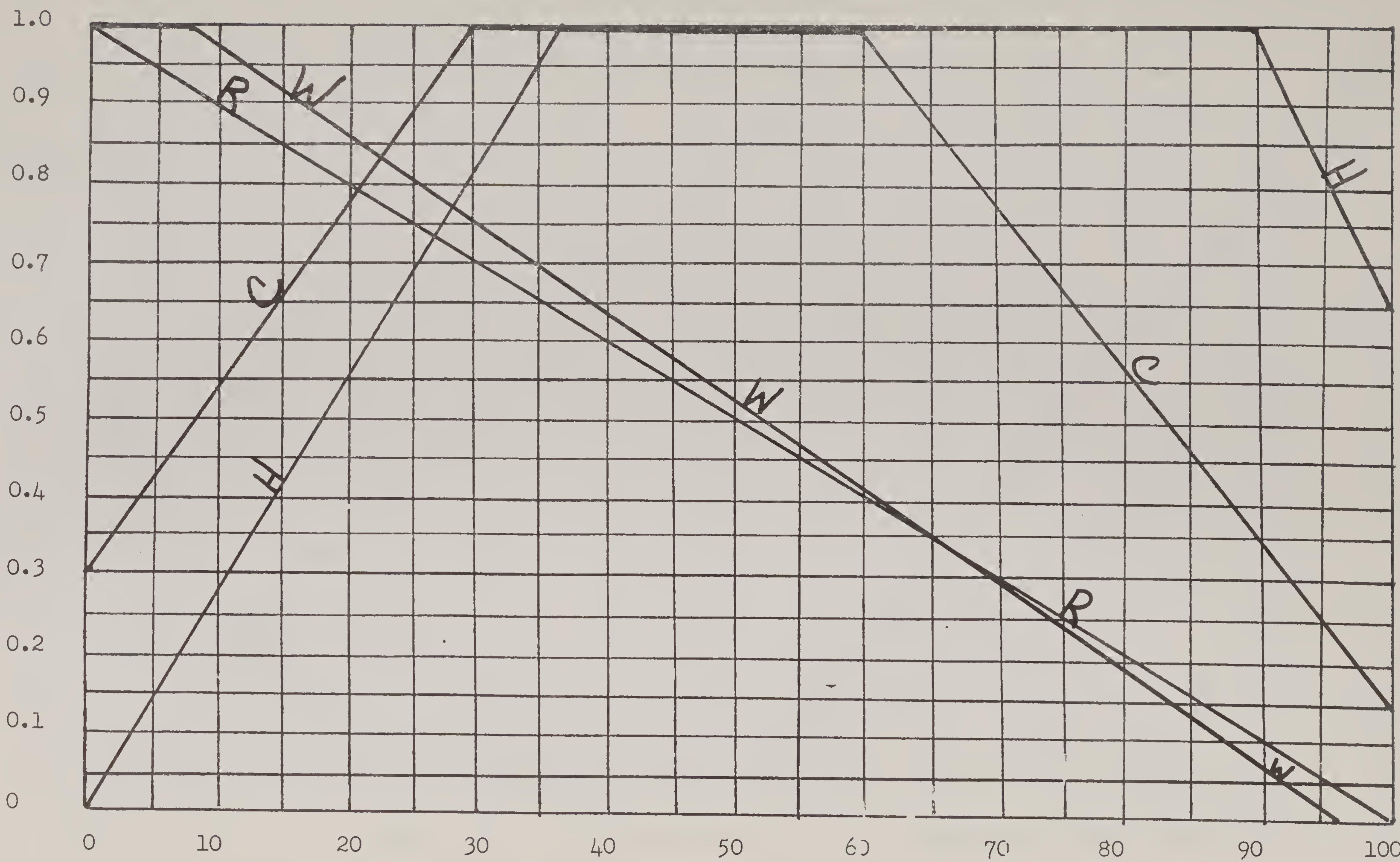


Figure 2 - Quantity factor - land use value transformation curve for Mockingbird

Cropland - C Woodland - W Herbaceous - H Rural-residential commercial - R

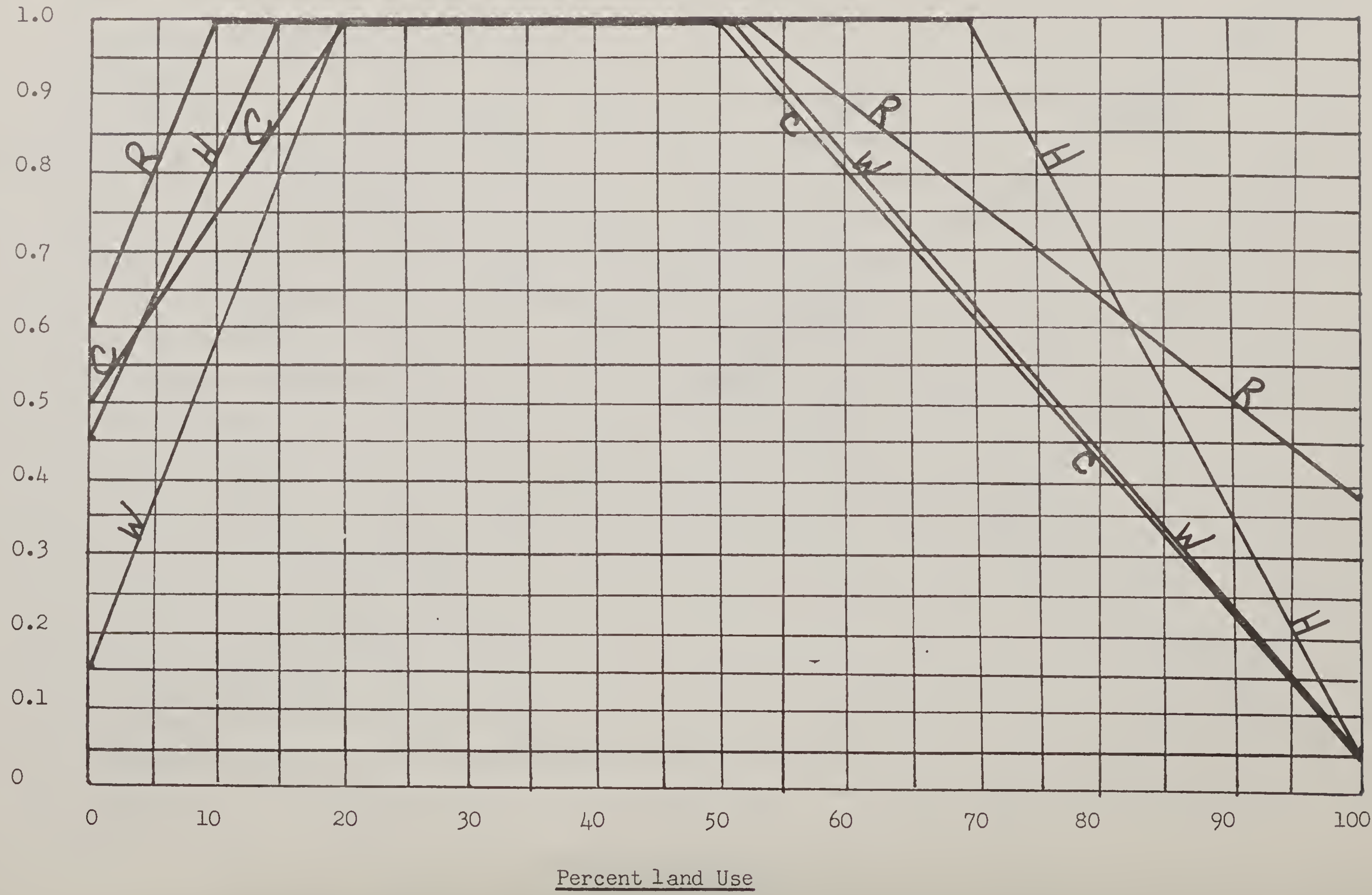


Figure 2 - Quantity factor - land use value transformation curve for
Wood Thrush

Cropland - C Woodland - W Herbaceous - H Rural-residential commercial - R

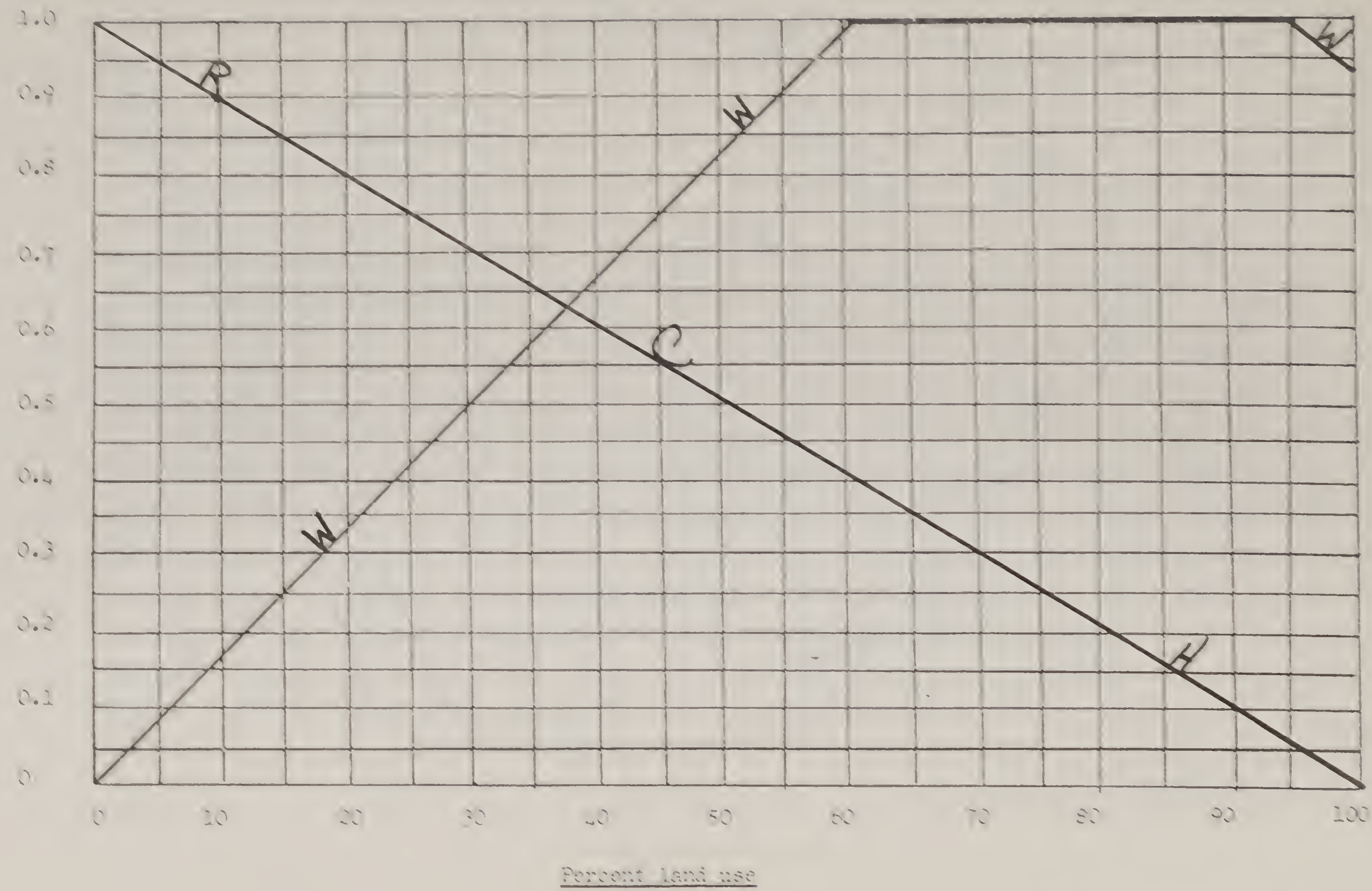


Figure 2 - Quantity factor - land use value transformation curve for

Fox

Cropland - C Woodland - W Herbaceous - H Rural-residential commercial - R

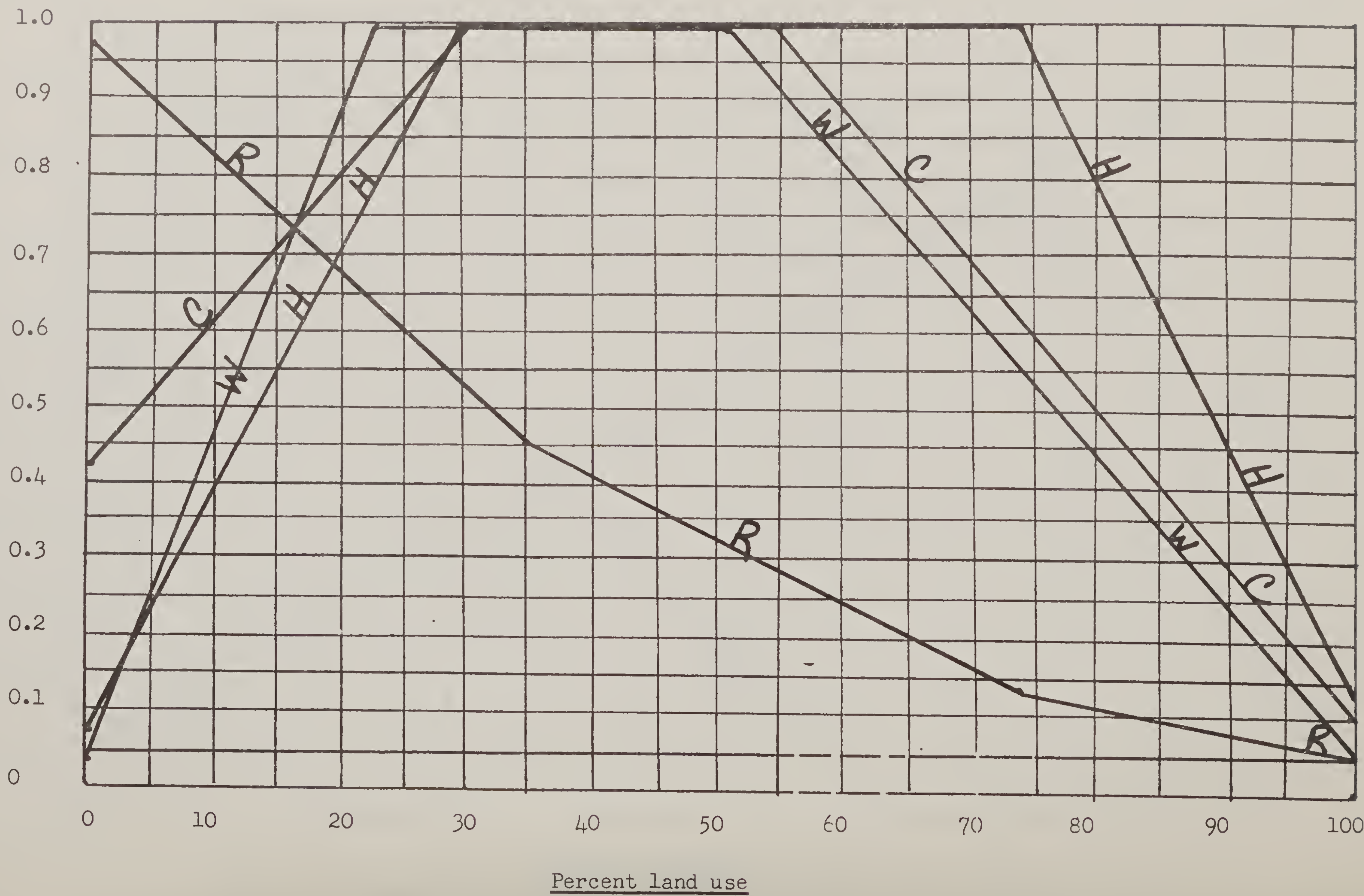


Figure 2 - Quantity factor - land use value transformation curve for

Raccoon

Cropland - C Woodland - W Herbaceous - H Rural-residential commercial - R

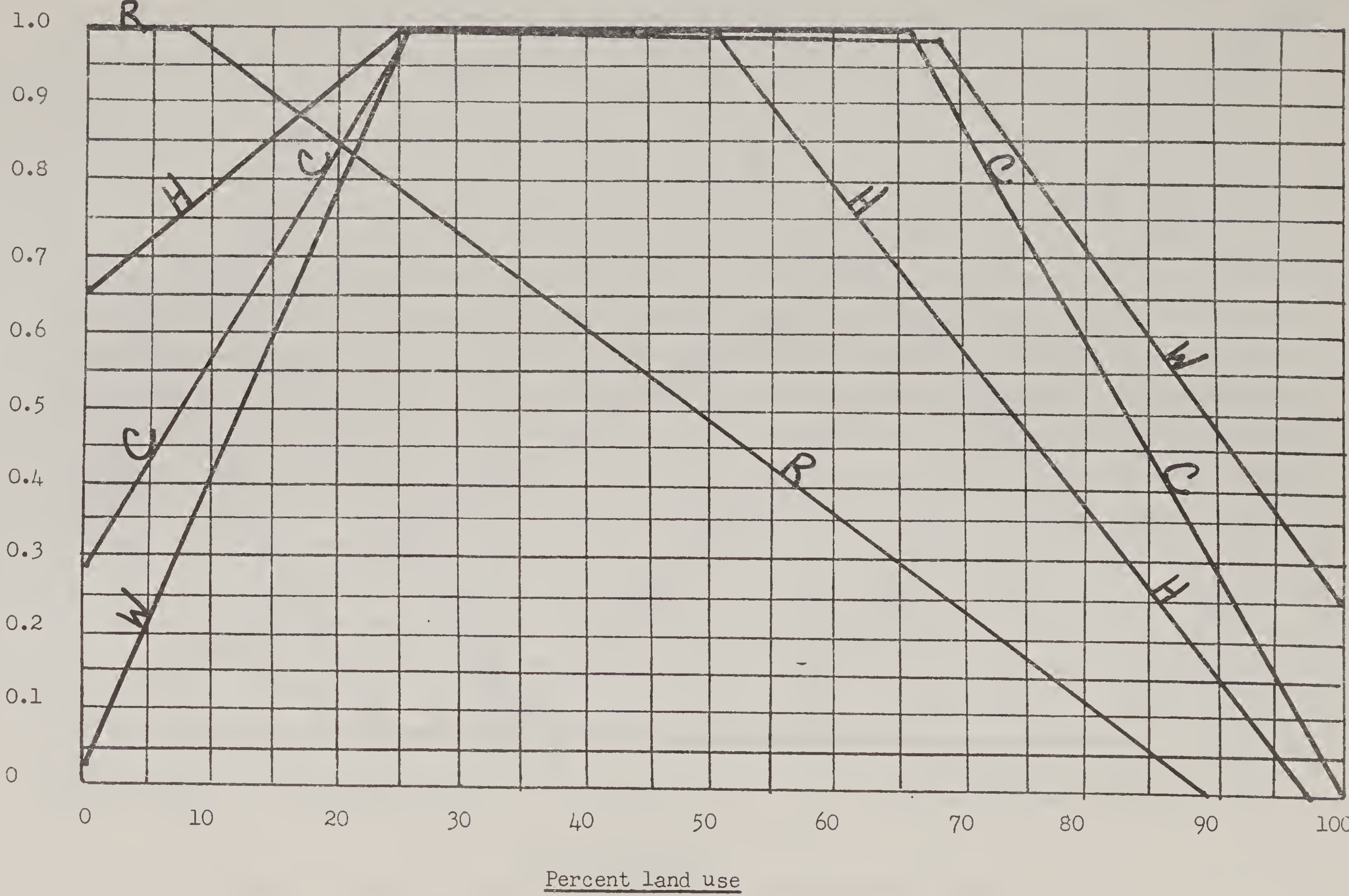


Figure 2 – Quantity factor – land use value transformation curve for

Kestrel

Cropland – C Woodland – W Herbaceous – H Rural-residential commercial – R

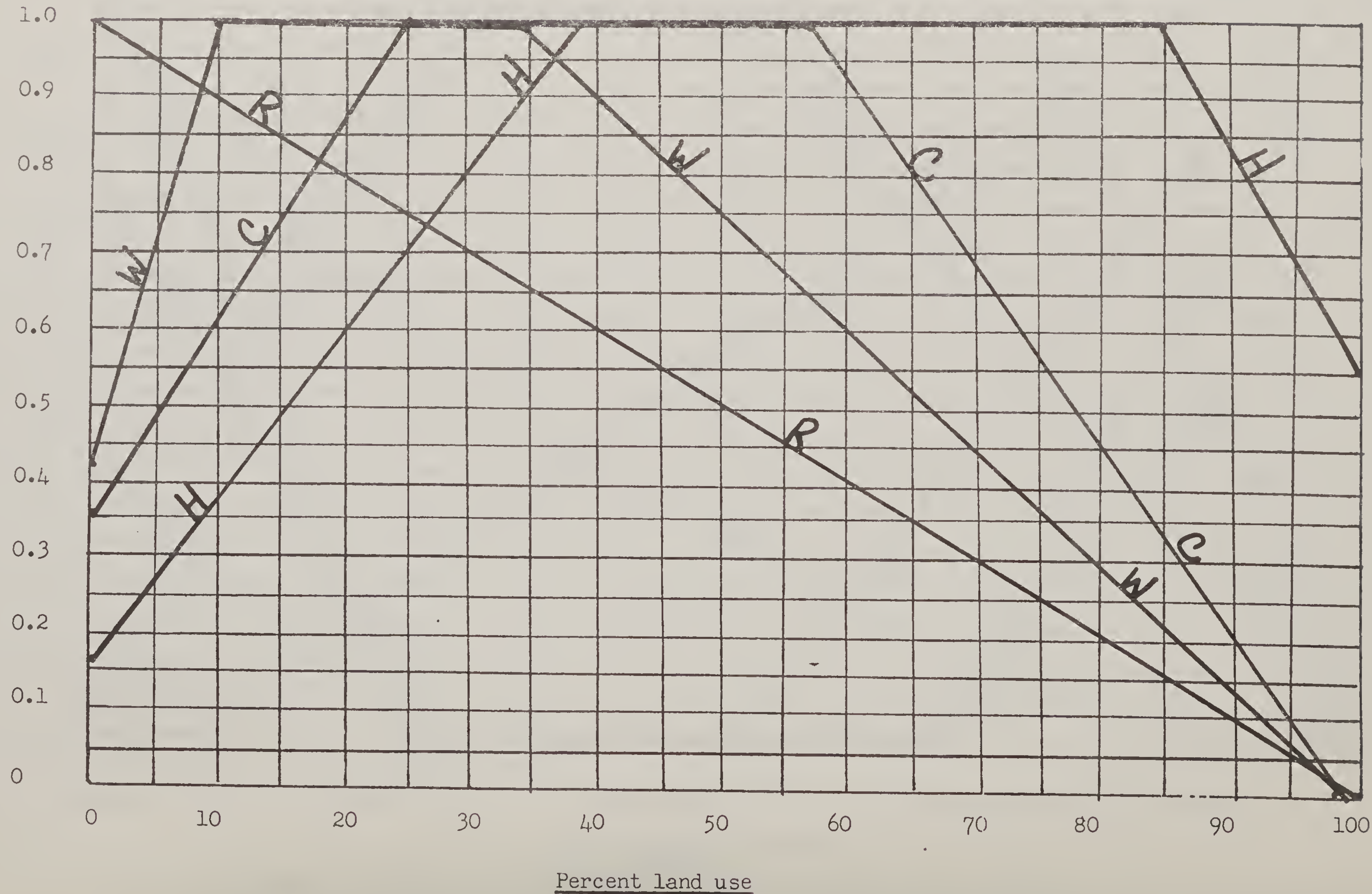


Figure 2 - Quantity factor - land use value transformation curve for

Black Racer

Cropland - C   Woodland - W   Herbaceous - H   Rural-residential commercial - R

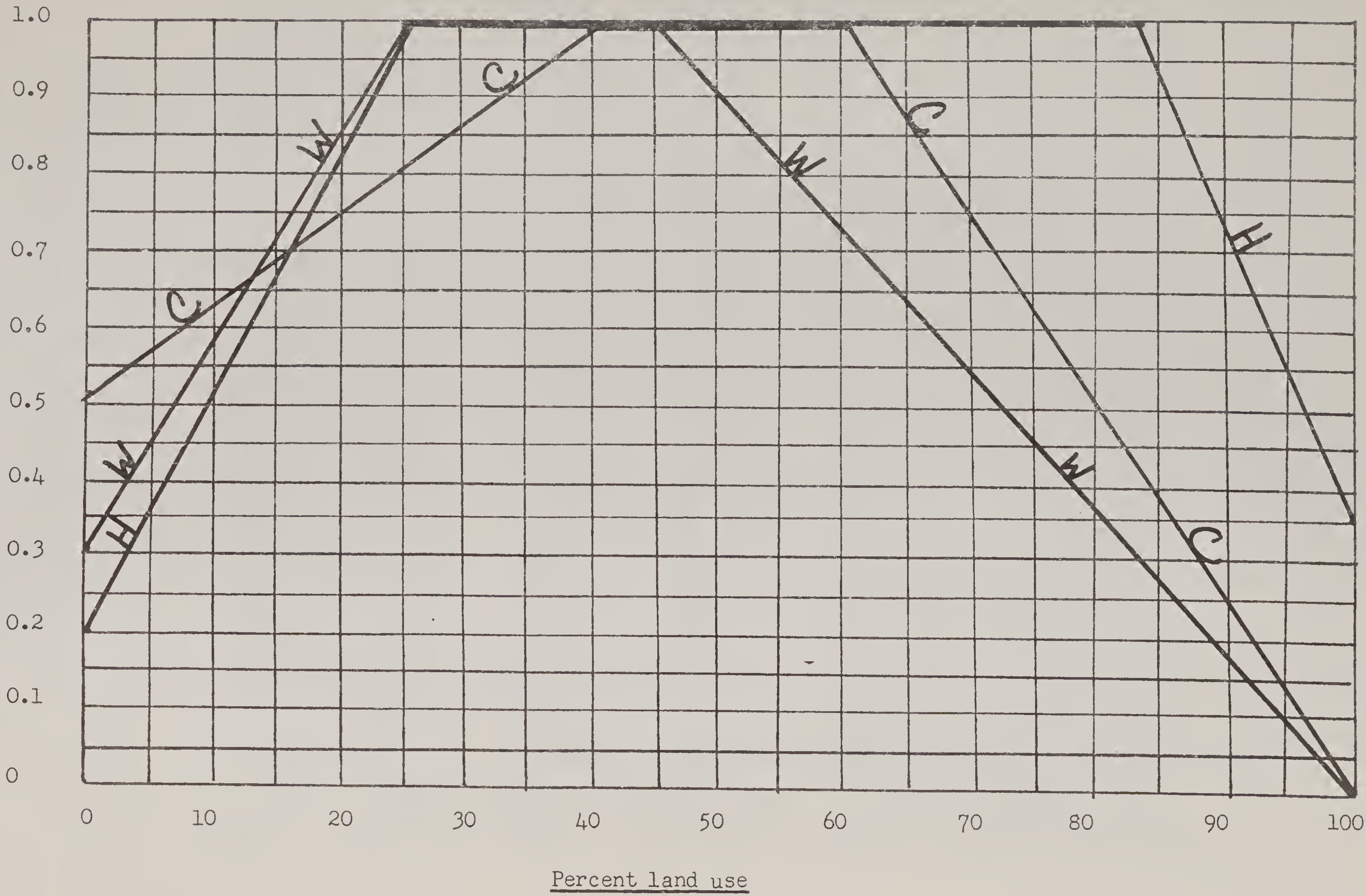


Table 3 - Weights to be applied to the habitat condition of the land uses to show their relative value for each species on a 1 to 100 scale.

(Total 100 for each specie)

	Quail	Rabbit	Squirrel-gray	Deer	Dove	Geese	Turkey	Field mice	Deer mice	Meadowlark	Mockingbird	Wood thrush	Fox	Raccoon	Kestrel	Black racer
Cropland	25	15	08	29	59	80	19	31	09	40	15	04	20	25	42	17
Herbaceous land	45	60	05	22	18	18	11	53	15	47	25	07	43	18	44	45
Rural residential-commercial	05	05	07	05	08	02	00	11	10	09	30	07	05	10	07	15
Woodland	25	20	80	44	15	00	70	05	66	04	30	82	32	47	07	23

Herbaceous wetland areas considered as herbaceous.

The data bank will serve as a baseline data set for future investigations. This correlated with predictive modeling of habitat changes enables biologists to predict effects of wildlife populations of any project activity or on trends such as development. The data collection, due to time restraints, was developed to satisfy areas of 6,070 ha. The reliability of data analysis on units of smaller size depends on sample size and variables addressed.

Index values for each of the 16 species are displayed in Table 4 for CNI watersheds. Four index values are displayed for watersheds where feasible projects exist. The present conditions were summarized and interpreted for all watersheds. Future conditions were projected for year 2000 without any project activity. Future conditions for areas where feasible projects occur were projected for year 2000 given two alternatives; one, would be with project construction and no wildlife management measures, and two, would be with project construction and willife management measures incorporated. The wildlife management measures that were selected are those incorporated in the main report, Table VI-D - Management alternatives for meeting 2000 needs. Many additional measures could be selected and incorporated into any plan and thus generate additional sets of index values. The ability of this system to generate projected wildlife habitat index values for any given activity demonstrates its practicality and usefulness in planning for the future wildlife.

If it is determined that additional wildlife species should be incorporated into the analysis procedure for greater detail, it will necessitate development of management weights, interspersion values and quantity curves for that species. The basic data and projection of future conditions can then be used for interpretive habitat analysis.

Through the application of this analysis procedure, the Delmarva region developed a cooperative working atmosphere among many varied interests and a data base to apply in decision making which was a consensus interpretation. Conflicts have been pointed out and attempts at solution are more successful due in part to greater knowledge and a better working relation.

The procedure applied in Delmarva takes considerable time to implement and it is tempting to use shortcuts. In smaller areas there are techniques for accomplishing this task. However, the habitat needs of all wildlife species are complex and often not fully understood. Temptation to oversimplify a procedure in the interest of time must be withstood to maintain credibility. Until we better define habitat needs for each species in measurable terms we must measure the management condition or vegetative type, interspersion and relative quantity of each land use to be able to formulate a valid index value.

Table 4 - Wildlife habitat index values.

Wildlife Habitat Index Values	
Legend	
Present	PRES
Future 2000 without project	W/OP 1
Future 2000 with project alternative 1	W/P1 2
Future 2000 with project alternative 2	W/P2 3

0108 CHESAPEAKE EAST

SPECIES	PRES	W/OP	W/P
QUAIL	2337	2413	
RABBIT	2542	2549	
SQUIRREL	2893	2885	
DEER	4721	4734	
DOVE	5849	5840	
GEESE	7520	7578	
TURKEY	6723	6791	
FIELD MICE	3061	3162	
DEER MICE	5103	5128	
MEADOWLARK	4985	4934	
MOCKINGBIRD	2399	2420	
WOODTHRUSH	5515	5494	
FOX	5084	5131	
RACCOON	4790	4742	
KESTREL	4229	4327	
BLACK RACER	5509	5607	

0109 CORSICA RIVER

SPECIES	PRES	W/OP	W/P
QUAIL	3082	3440	
RABBIT	2952	3343	
SQUIRREL	3187	3210	
DEER	4905	5050	
DOVE	5318	5355	
GEESE	6835	6815	
TURKEY	6637	6799	
FIELD MICE	3470	3808	
DEER MICE	5454	5563	
MEADOWLARK	4963	5145	
MOCKINGBIRD	3024	312[illegible]	
WOODTHRUSH	5645	5749	
FOX	5266	5581	
RACCOON	4886	4973	
KESTREL	3970	4235	
BLACK RACER	5165	5415	

0110 WYE MILLS

SPECIES	PRES	W/CP	W/P
QUAIL	1506	1605	
RABBIT	1908	2033	
SQUIRREL	2998	2986	
DEER	4277	4244	
DOVE	4954	4929	
GEESE	7089	7047	
TURKEY	7180	7174	
FIELD MICE	2566	2639	
DEER MICE	4892	4847	
MEADOWLARK	5521	5234	
MOCKINGBIRD	1955	2065	
WOODTHRUSH	5554	5512	
FOX	4931	4904	
RACCOON	3935	3886	
KESTREL	4122	4159	
BLACK RACER	5978	5826	

0113 LOWER CHESAPEAKE

SPECIES	PRES	W/OP	W/P
QUAIL	187	192	
RABBIT	615	633	
SQUIRREL	816	815	
DEER	1784	1759	
DOVE	4798	4726	
GEESE	632	625	
TURKEY	4078	4053	
FIELD MICE	698	719	
DEER MICE	1479	1437	
MEADOWLARK	3106	3004	
MOCKINGBIRD	215	219	
WOODTHRUSH	1966	1946	
FOX	2461	2463	
RACCOON	1998	1939	
KESTREL	2651	2633	
BLACK RACER	3913	4008	

0114 UPPER MANOKIN

SPECIES	PRES	W/OP	W/P
QUAIL	3053	3070	
RABBIT	3346	3327	
SQUIRREL	2393	2393	
DEER	4398	4273	
DOVE	5460	5181	
GEESE	612	585	
TURKEY	5393	5225	
FIELD MICE	2856	2721	
DEER MICE	4010	3977	
MEADOWLARK	3870	3566	
MOCKINGBIRD	3533	3524	
WOODTHRUSH	4953	4828	
FOX	3786	3588	
RACCOON	4399	4201	
KESTREL	4563	4407	
BLACK RACER	5788	5699	

0115 KINGS CREEK

SPECIES	PRES	W/CP	W/P
QUAIL	2085	2177	
RABBIT	2060	2165	
SQUIRREL	1186	1191	
DEER	3444	3399	
DOVE	4345	4319	
GEESE	613	617	
TURKEY	6119	6168	
FIELD MICE	1631	1731	
DEER MICE	4015	4020	
MEADOWLARK	2635	2898	
MOCKINGBIRD	1719	1749	
WOODTHRUSH	5146	5118	
FOX	3450	3481	
RACCOON	3979	3866	
KESTREL	3662	3757	
BLACK RACER	4154	4248	

1 Future 2000 without project was developed by projecting present conditions and trends.
2 Future 2000 with alternative 1 was developed by determining constructed conditions without incorporating wildlife management measures.
3 Future 2000 with alternative 2 was developed by incorporating wildlife management measures in addition to project construction.

Table 4 - Wildlife habitat index values.

0116 TURKEY BRANCH

SPECIES	PRES	W/OP	W/P
QUAIL	3641	3713	
RABBIT	3616	3709	
SQUIRREL	2418	2433	
DEER	4799	4745	
DOVE	5898	5768	
GEESE	603	639	
TURKEY	5886	5850	
FIELD MICE	3145	3237	
DEER MICE	3992	3950	
MEADOWLARK	3050	3593	
MOCKINGBIRD	3352	3329	
WOODTHRUSH	5233	5178	
FOX	4397	4324	
RACCOON	5300	5163	
KESTREL	4279	4494	
BLACK RACER	5658	5571	

0117 MARUMSCO

SPECIES	PRES	W/OP	W/P
QUAIL	2835	2972	
RABBIT	3059	3146	
SQUIRREL	1462	1462	
DEER	3956	3899	
DOVE	5302	5184	
GEESE	641	648	
TURKEY	5764	5753	
FIELD MICE	2916	2954	
DEER MICE	3825	3835	
MEADOWLARK	3731	3555	
MOCKINGBIRD	2789	2839	
WOODTHRUSH	4907	4885	
FOX	3981	3938	
RACCOON	4925	4800	
KESTREL	4629	4706	
BLACK RACER	4903	4970	

0120 UPPER VIRGINIA

SPECIES	PRES	W/OP	W/P
QUAIL	259	262	
RABBIT	878	895	
SQUIRREL	842	846	
DEER	1859	1858	
DOVE	4437	4491	
GEESE	312	314	
TURKEY	3722	3728	
FIELD MICE	1120	1143	
DEER MICE	1257	1260	
MEADOWLARK	3005	3035	
MOCKINGBIRD	193	194	
WOODTHRUSH	1778	1777	
FOX	3076	3091	
RACCOON	2260	2262	
KESTREL	2868	2886	
BLACK RACER	3765	3812	

0120-1 BULBEGGAR CREEK

SPECIES	PRES	W/OP	W/P1	W/P2
QUAIL	2311	2300	2318	2456
RABBIT	2510	2512	2548	2578
SQUIRREL	1900	1921	1888	2006
DEER	4059	4022	4090	4335
DOVE	4829	4740	4842	5143
GEESE	367	375	396	425
TURKEY	6214	6189	6248	6514
FIELD MICE	2396	2335	2483	2493
DEER MICE	4690	4679	4716	5098
MEADOWLARK	3328	3226	3452	3382
MOCKINGBIRD	2771	2772	2770	3123
WOODTHRUSH	5346	5333	5347	5660
FOX	3911	3826	3975	4065
RACCOON	4738	4688	4742	4960
KESTREL	4422	4345	4498	4838
BLACK RACER	5166	5172	5233	5369

0120-2 HOLDEN'S CREEK

SPECIES	PRES	W/OP	W/P1	W/P2
QUAIL	2221	2253	2072	2331
RABBIT	2398	2469	2221	2618
SQUIRREL	1758	1764	1734	1841
DEER	3660	3629	3689	4001
DOVE	4130	3969	3878	4911
GEESE	276	278	287	332
TURKEY	6056	6038	6059	6379
FIELD MICE	2582	2575	2426	2910
DEER MICE	4370	4341	4304	4869
MEADOWLARK	3690	3578	3592	4189
MOCKINGBIRD	2813	2808	2734	3189
WOODTHRUSH	4875	4843	4862	5168
FOX	4035	4005	3924	4368
RACCOON	4132	4026	4069	4431
KESTREL	4113	4147	4067	4893
BLACK RACER	4821	4837	4619	5432

0120-3 JACK'S CREEK

SPECIES	PRES	W/OP	W/P1	W/P2
QUAIL	538	552	478	612
RABBIT	1146	1140	934	1094
SQUIRREL	1191	1208	1214	1366
DEER	2463	2433	2413	2764
DOVE	4729	4732	3993	4910
GEESE	271	260	259	280
TURKEY	4140	3950	3957	4350
FIELD MICE	1231	1166	915	1258
DEER MICE	2474	2488	2252	3114
MEADOWLARK	2438	2269	1834	2560
MOCKINGBIRD	567	576	492	879
WOODTHRUSH	2542	2481	2493	2916
FOX	2651	2502	2312	2664
RACCOON	2622	2576	2573	2834
KESTREL	3321	3232	3119	3560
BLACK RACER	4421	4424	3423	4595

Table 4 – Wildlife habitat index values.

0120-4 MESSONGO CREEK

SPECIES	PRES	W/OP	W/P
QUAIL	316	325	302
RABBIT	846	875	794
SQUIRREL	575	573	567
DEER	1685	1670	1716
DOVE	2942	2885	2792
GEESE	226	227	0235
TURKEY	4068	4081	4060
FIELD MICE	887	908	856
DEER MICE	1569	1574	1540
MEADOWLARK	1989	2013	1932
MOCKINGBIRD	339	343	327
WOODTHRUSH	2330	2322	2350
FOX	2499	2526	2502
RACCOON	2373	2320	2389
KESTREL	2640	2635	2706
BLACK RACER	3282	3373	3065

0120-5 CATTAIL CREEK

SPECIES	PRES	W/OP	W/P
QUAIL	543	543	
RABBIT	1651	1638	
SQUIRREL	788	798	
DEER	2105	2080	
DOVE	4639	4593	
GEESE	278	266	
TURKEY	3038	2900	
FIELD MICE	1218	1140	
DEER MICE	1107	1109	
MEADOWLARK	1921	1404	
MOCKINGBIRD	263	264	
WOODTHRUSH	1740	1699	
FOX	2470	2317	
RACCOON	2841	2757	
KESTREL	2620	2523	
BLACK RACER	3627	3607	

0120-6 MUDDY CREEK

SPECIES	PRES	W/OP	W/P
QUAIL	699	695	
RABBIT	1520	1512	
SQUIRREL	774	780	
DEER	2325	2284	
DOVE	3869	3724	
GEESE	270	257	
TURKEY	3971	3926	
FIELD MICE	1444	1397	
DEER MICE	1531	1524	
MEADOWLARK	2987	2847	
MOCKINGBIRD	393	391	
WOODTHRUSH	2523	2515	
FOX	2961	2881	
RACCOON	3509	3446	
KESTREL	3301	3203	
BLACK RACER	3336	3299	

0120-7 GUILFORD CREEK

SPECIES	PRES	W/OP	W/P1	W/P2
QUAIL	2083	2105	2085	2354
RABBIT	2712	2710	2872	2907
SQUIRREL	1264	1276	1269	1445
DEER	3556	3522	3589	3907
DOVE	4266	4228	4300	4971
GEESE	277	275	282	341
TURKEY	4702	4659	4754	5106
FIELD MICE	2539	2492	2565	2717
DEER MICE	3414	3393	3435	3885
MEADOWLARK	3501	3351	3700	3908
MOCKINGBIRD	2463	2459	2489	2913
WOODTHRUSH	4374	4352	4387	4824
FOX	3662	3602	3682	3822
RACCOON	4231	4161	4223	4564
KESTREL	4242	4157	4360	4961
BLACK RACER	4781	4739	4840	5181

0120-8 PUNGOTEAGUE CREEK

SPECIES	PRES	W/OP	W/P1	W/P2
QUAIL	2131	2162	2127	2279
RABBIT	2370	2436	2412	2432
SQUIRREL	1666	1676	1647	1726
DEER	3896	3903	3887	4136
DOVE	4421	4515	4359	4733
GEESE	303	309	302	315
TURKEY	5189	5211	5187	5320
FIELD MICE	2574	2643	2678	2596
DEER MICE	3403	3407	3426	3786
MEADOWLARK	3658	3807	3768	3695
MOCKINGBIRD	2440	2446	2426	2947
WOODTHRUSH	4731	4723	4727	4989
FOX	3849	3898	3919	3889
RACCOON	4446	4429	4426	4509
KESTREL	4009	4084	4037	4298
BLACK RACER	4936	4983	5009	5049

0129 LOWER VIRGINIA

SPECIES	PRES	W/OP	W/P
QUAIL	1690	1752	
RABBIT	2223	2397	
SQUIRREL	1832	1841	
DEER	3790	3806	
DOVE	4250	4416	
GEESE	318	327	
TURKEY	4725	4779	
FIELD MICE	2487	2727	
DEER MICE	2522	2560	
MEADOWLARK	3639	3856	
MOCKINGBIRD	1444	1479	
WOODTHRUSH	3834	3844	
FOX	3734	3919	
RACCOON	4434	4437	
KESTREL	4016	4110	
BLACK RACER	3774	4002	

Table 4 - Wildlife habitat index values.

0203-1 SMYRNA RIVER

SPECIES	PRES	W/OP	W/P
QUAIL	1536	1589	
RABBIT	1937	2034	
SQUIRREL	2237	2233	
DEER	3887	3895	
DOVE	4007	4044	
GEESE	4734	4765	
TURKEY	6054	6122	
FIELD MICE	2184	2341	
DEER MICE	3789	3851	
MEADOWLARK	3560	3665	
MOCKINGBIRD	1337	1374	
WOODTHRUSH	4415	4432	
FOX	4527	4656	
RACCOON	4072	4043	
KESTREL	3274	3329	
BLACK RACER	4200	4376	

0203-2 BLACKBIRD CREEK

SPECIES	PRES	W/OP	W/P
QUAIL	1316	1331	
RABBIT	1764	1790	
SQUIRREL	1805	1806	
DEER	3512	3508	
DOVE	4650	4617	
GEESE	5851	5837	
TURKEY	6182	6184	
FIELD MICE	2278	2296	
DEER MICE	4163	4173	
MEADOWLARK	3990	3979	
MOCKINGBIRD	1375	1403	
WOODTHRUSH	4309	4311	
FOX	4409	4421	
RACCOON	3658	3640	
KESTREL	4137	4152	
BLACK RACER	4894	4931	

0203-3 APPOQUINIMINK RIVER

SPECIES	PRES	W/OP	W/P
QUAIL	1866	1934	
RABBIT	2028	2117	
SQUIRREL	2385	2390	
DEER	4340	4369	
DOVE	5141	5203	
GEESE	6856	6864	
TURKEY	6067	6135	
FIELD MICE	2445	2543	
DEER MICE	4796	4847	
MEADOWLARK	4025	4066	
MOCKINGBIRD	1677	1705	
WOODTHRUSH	4892	4933	
FOX	4992	5052	
RACCOON	4084	4093	
KESTREL	3519	3574	
BLACK RACER	4551	4662	

0203-4 OTHER AREAS

SPECIES	PRES	W/OP	W/P
QUAIL	2604	2605.	
RABBIT	2642	2644	
SQUIRREL	2499	2502	
DEER	4658	4658	
DOVE	4744	4738	
GEESE	6839	6836	
TURKEY	7006	7007	
FIELD MICE	2662	2661	
DEER MICE	5382	5381	
MEADOWLARK	3631	3625	
MOCKINGBIRD	2232	2232	
WOODTHRUSH	5706	5705	
FOX	4798	4795	
RACCOON	4708	4705	
KESTREL	3717	3718	
BLACK RACER	4612	4611	

0203-5 CEDAR SWAMP

SPECIES	PRES	W/OP	W/P
QUAIL	772	787	
RABBIT	825	854	
SQUIRREL	445	447	
DEER	2021	2017	
DOVE	4721	4698	
GEESE	5635	5761	
TURKEY	3876	3895	
FIELD MICE	715	733	
DEER MICE	1512	1518	
MEADOWLARK	1313	1385	
MOCKINGBIRD	333	335	
WOODTHRUSH	2013	2012	
FOX	2220	2233	
RACCOON	1951	1943	
KESTREL	1932	1943	
BLACK RACER	2226	2278	

0204 LEIPSIC

SPECIES	PRES	W/OP	W/P
QUAIL	135	139	
RABBIT	467	482	
SQUIRREL	1258	1259	
DEER	1882	1885	
DOVE	4657	4685	
GEESE	5117	5161	
TURKEY	4942	4976	
FIELD MICE	865	893	
DEER MICE	2081	2094	
MEADOWLARK	3357	3390	
MOCKINGBIRD	117	119	
WOODTHRUSH	1822	1821	
FOX	4056	4096	
RACCOON	1590	1581	
KESTREL	2162	2190	
BLACK RACER	4231	4317	

Table 4 - Wildlife habitat index values.

0205 MURDERKILL

SPECIES	PRES	W/OP	W/P1	W/P2
QUAIL	2255	2303	2202	2544
RABBIT	2444	2543	2367	2866
SQUIRREL	2333	2339	2309	2409
DEER	4357	4388	4326	4649
DOVE	4779	4831	4647	5285
GEESE	4475	4562	4446	4730
TURKEY	6184	6255	6131	6461
FIELD MICE	2959	3079	2834	3276
DEER MICE	4506	4529	4453	4960
MEADOWLARK	4048	4190	3943	4435
MOCKINGBIRD	2026	2046	1999	2531
WOODTHRUSH	5185	5199	5159	5516
FOX	4989	5081	4906	5304
RACCOON	4660	4657	4618	4855
KESTREL	3946	4020	3880	4493
BLACK RACER	4721	4821	4577	5208

0206 MISPILLION

SPECIES	PRES	W/OP	W/P
QUAIL	1062	1083	
RABBIT	1623	1681	
SQUIRREL	1987	1995	
DEER	3468	3482	
DOVE	4751	4784	
GEESE	2708	2738	
TURKEY	5908	5958	
FIELD MICE	2134	2194	
DEER MICE	3604	3621	
MEADOWLARK	3597	3682	
MOCKINGBIRD	1031	1042	
WOODTHRUSH	3946	3948	
FOX	4464	4524	
RACCOON	3698	3688	
KESTREL	3662	3706	
BLACK RACER	4478	4564	

0207 BROADKILL

SPECIES	PRES	W/CP	W/P
QUAIL	527	530	
RABBIT	1142	1151	
SQUIRREL	1377	1378	
DEER	2610	2614	
DOVE	5142	5148	
GEESE	2003	2018	
TURKEY	4827	4838	
FIELD MICE	1714	1729	
DEER MICE	2519	2521	
MEADOWLARK	3797	3829	
MOCKINGBIRD	472	472	
WOODTHRUSH	2510	2508	
FOX	4376	4384	
RACCOON	2479	2476	
KESTREL	3091	3107	
BLACK RACER	4707	4728	

0301 INDIAN RIVER

SPECIES	PRES	W/OP	W/P
QUAIL	1454	1511	
RABBIT	2116	2219	
SQUIRREL	2091	2084	
DEER	3642	3648	
DOVE	5496	5504	
GEESE	1773	1816	
TURKEY	5230	5273	
FIELD MICE	2438	2555	
DEER MICE	3039	3050	
MEADOWLARK	3936	4061	
MOCKINGBIRD	1452	1469	
WOODTHRUSH	3886	3874	
FOX	4107	4179	
RACCOON	3961	3913	
KESTREL	3888	3997	
BLACK RACER	4785	4903	

0302 BEAR HOLE

SPECIES	PRES	W/OP	W/P
QUAIL	3644	3902	
RABBIT	3268	3721	
SQUIRREL	2513	2555	
DEER	4602	4791	
DOVE	5987	5892	
GEESE	2382	2473	
TURKEY	5840	5991	
FIELD MICE	5066	5068	
DEER MICE	4307	4307	
MEADOWLARK	5535	5452	
MOCKINGBIRD	3513	3514	
WOODTHRUSH	4984	4985	
FOX	5835	5779	
RACCOON	4740	4720	
KESTREL	5286	5556	
BLACK RACER	5513	5471	

0307 LOWER VIRGINIA

SPECIES	PRES	W/CP	W/P
QUAIL	53	55	
RABBIT	319	329	
SQUIRREL	509	512	
DEER	1134	1134	
DOVE	3825	3972	
GEESE	311	312	
TURKEY	3335	3343	
FIELD MICE	508	531	
DEER MICE	883	890	
MEADOWLARK	2512	2545	
MOCKINGBIRD	33	33	
WOODTHRUSH	928	930	
FOX	2739	2790	
RACCOON	1132	1134	
KESTREL	2180	2199	
BLACK RACER	2755	2840	

Table 4 – Wildlife habitat index values.

0307-1 TOMMY'S DITCH

SPECIES	PRES	W/OP	W/P
QUAIL	1281	1283	1274
RABBIT	0	0	0
SQUIRREL	2133	2172	2028
DEER	3759	3779	3690
DOVE	3127	3112	3160
GEESE	245	242	252
TURKEY	4501	4505	4474
FIELD MICE	1110	1110	1103
DEER MICE	2273	2270	2276
MEADOWLARK	2410	2399	2446
MOCKINGBIRD	787	788	785
WOODTHRUSH	[illegible]	3179	[illegible]
FOX	2715	2706	2720
RACCOON	3416	3419	3400
KESTREL	2792	2781	2809
BLACK RACER	1904	1905	1896

0308 LOWER CHINCOTEAGUE

SPECIES	PRES	W/OP	W/P
QUAIL	228	233	
RABBIT	772	792	
SQUIRREL	930	931	
DEER	1902	1903	
DOVE	4162	4201	
GEESE	489	493	
TURKEY	4141	4149	
FIELD MICE	948	981	
DEER MICE	1420	1429	
MEADOWLARK	3143	3171	
MOCKINGBIRD	205	207	
WOODTHRUSH	1984	[illegible]	
FOX	3027	3073	
RACCOON	2133	2128	
KESTREL	2921	2952	
BLACK RACER	3662	3737	

0318 CHINCOTEAGUE

SPECIES	PRES	W/CP	W/P
QUAIL	1149	1192	
RABBIT	1783	1902	
SQUIRREL	2362	2355	
DEER	3670	3650	
DOVE	5653	5583	
GEESE	733	734	
TURKEY	5109	5153	
FIELD MICE	1838	1955	
DEER MICE	2766	2798	
MEADOWLARK	3529	3553	
MOCKINGBIRD	1039	1063	
WOODTHRUSH	[illegible]	[illegible]	
FOX	3421	3564	
RACCOON	3325	3355	
KESTREL	3617	3851	
BLACK RACER	4322	4519	

0318-1 TURVILLE

SPECIES	PRES	W/OP	W/P
QUAIL	5177	4766	
RABBIT	0	4220	
SQUIRREL	3863	3722	
DEER	6058	5387	
DOVE	6953	5984	
GEESE	0	0	
TURKEY	6776	6542	
FIELD MICE	5347	4531	
DEER MICE	6192	5528	
MEADOWLARK	5695	5121	
MOCKINGBIRD	5695	4797	
WOODTHRUSH	6440	5936	
FOX	5751	5063	
RACCOON	6302	5628	
KESTREL	5941	5579	
BLACK RACER	7064	6010	

0319 SHINGLE LANDING

SPECIES	PRES	W/OP	W/P
QUAIL	3938	4226	
RABBIT	3453	3764	
SQUIRREL	2292	2299	
DEER	4826	4393	
DOVE	5580	5520	
GEESE	659	666	
TURKEY	5847	5955	
FIELD MICE	4380	4501	
DEER MICE	4501	4522	
MEADOWLARK	5354	5207	
MOCKINGBIRD	3319	3398	
WOODTHRUSH	5370	5338	
FOX	5194	5171	
RACCOON	5426	5340	
KESTREL	4811	5030	
BLACK RACER	5239	5362	

0320 KITTS TAYLORVILLE

SPECIES	PRES	W/CP	W/P1	[illegible]
QUAIL	2380	2509	[illegible]	[illegible]
RABBIT	2233	2428	2244	[illegible]
SQUIRREL	3427	3410	[illegible]	[illegible]
DEER	4966	4939	[illegible]	[illegible]
DOVE	5573	5575	[illegible]	[illegible]
GEESE	641	664	[illegible]	[illegible]
TURKEY	6578	6667	6536	[illegible]
FIELD MICE	2266	2476	2313	[illegible]
DEER MICE	4854	4921	4899	[illegible]
MEADOWLARK	3238	3566	3250	[illegible]
MOCKINGBIRD	2612	2671	2551	[illegible]
WOODTHRUSH	5595	5586	5594	5855
FOX	3859	4012	3889	4035
RACCOON	4971	4865	4976	5106
KESTREL	4434	4535	4436	[illegible]
BLACK RACER	4519	4781	4598	4917

Table 4 – Wildlife habitat index values.

0406-1 BOHEMIA RIVER

SPECIES	PRES	W/OP	W/P
QUAIL	2765	2773	
RABBIT	3465	3464	
SQUIRREL	2314	2321	
DEER	4758	4759	
DOVE	5537	5545	
GEESE	7917	7899	
TURKEY	7153	7159	
FIELD MICE	3646	3634	
DEER MICE	4694	4692	
MEADOWLARK	5822	5776	
MOCKINGBIRD	2314	2317	
WOODTHRUSH	5753	5755	
FOX	5675	5652	
RACCOON	5263	5264	
KESTREL	4413	4413	
BLACK RACER	5792	5782	

0406-2 SASSAFRAS RIVER

SPECIES	PRES	W/OP	W/P
QUAIL	3030	3051	
RABBIT	3119	3128	
SQUIRREL	2537	2538	
DEER	4844	4355	
DOVE	5265	5276	
GEESE	7469	7456	
TURKEY	7076	7094	
FIELD MICE	3540	3549	
DEER MICE	5369	5361	
MEADOWLARK	5394	5354	
MOCKINGBIRD	2357	2359	
WOODTHRUSH	6042	6049	
FOX	5467	5439	
RACCOON	5241	5248	
KESTREL	4171	4190	
BLACK RACER	5509	5487	

0406-3 OTHER -BLACK CREEK

SPECIES	PRES	W/OP	W/P
QUAIL	2040	2035	
RABBIT	2408	2393	
SQUIRREL	3112	3138	
DEER	4838	4846	
DOVE	5654	5652	
GEESE	7626	7597	
TURKEY	7312	7280	
FIELD MICE	2484	2440	
DEER MICE	5226	5207	
MEADOWLARK	5061	4943	
MOCKINGBIRD	2586	2576	
WOODTHRUSH	5710	5695	
FOX	4645	4559	
RACCOON	4274	4273	
KESTREL	4497	4502	
BLACK RACER	5512	5460	

0406-4 OTHER -CRYSTAL BEACH

SPECIES	PRES	W/OP	W/P
QUAIL	3120	3132	
RABBIT	3512	3516	
SQUIRREL	2913	2934	
DEER	4954	4961	
DOVE	5248	5258	
GEESE	7478	7465	
TURKEY	7293	7282	
FIELD MICE	3734	3715	
DEER MICE	4860	4860	
MEADOWLARK	5312	5272	
MOCKINGBIRD	2829	2834	
WOODTHRUSH	5863	5859	
FOX	5031	5005	
RACCOON	5554	5557	
KESTREL	4828	4843	
BLACK RACER	5508	5510	

0501 ANDOVER BRANCH

SPECIES	PRES	W/OP	W/P1	W/P2
QUAIL	2837	2888	2794	3226
RABBIT	2973	3037	2935	3603
SQUIRREL	2565	2563	2564	2621
DEER	4578	4601	4584	5031
DOVE	4803	4782	4703	5452
GEESE	2288	2304	2310	2526
TURKEY	7192	7222	7197	7565
FIELD MICE	3564	3565	3547	3949
DEER MICE	5516	5500	5507	5918
MEADOWLARK	5080	5051	5058	5708
MOCKINGBIRD	3010	3019	3007	3643
WOODTHRUSH	6302	6284	6315	6572
FOX	5179	5152	5199	5538
RACCOON	5007	4982	4971	5283
KESTREL	4444	4499	4408	5347
BLACK RACER	5991	5976	5959	6661

0502 CHESTER RIVER

SPECIES	PRES	W/OP	W/P1	W/P2
QUAIL	2632	2723	2567	2829
RABBIT	2656	2744	2601	3052
SQUIRREL	2624	2621	2597	2670
DEER	4776	4823	4724	5070
DOVE	5505	5567	5385	5680
GEESE	7430	7420	7370	7803
TURKEY	6827	6913	6766	7082
FIELD MICE	3151	3273	3101	3487
DEER MICE	5547	5586	5541	5905
MEADOWLARK	5145	5124	5064	5327
MOCKINGBIRD	2453	2480	2431	2883
WOODTHRUSH	5782	5817	5755	6010
FOX	5490	5560	5448	5838
RACCOON	4716	4738	4668	4907
KESTREL	3792	3880	3736	4410
BLACK RACER	5352	5418	5320	5788

Table 4 – Wildlife habitat index values.

0503 UNICORN BRANCH

SPECIES	PRES	W/OP	W/P1	W/P2
QUAIL	2437	2494	2262	2306
RABBIT	2745	2758	2648	2756
SQUIRREL	2104	2103	2079	2077
DEER	4488	4490	4408	4645
DOVE	5078	5048	4808	5240
GEESE	5503	5457	5396	5850
TURKEY	7201	7280	7099	7469
FIELD MICE	3254	3216	3211	3315
DEER MICE	5615	5615	5606	5920
MEADOWLARK	5649	5373	5612	5823
MOCKINGBIRD	2502	2513	2433	2678
WOODTHRUSH	6285	6274	6227	6220
FOX	5635	5498	5638	5716
RACCOON	4698	4706	4575	4642
KESTREL	4288	4323	4165	4834
BLACK RACER	5875	5829	5837	6232

0504 DUDLEY BRANCH

SPECIES	PRES	W/OP	W/P1	W/P2
QUAIL	3050	3092	2882	3208
RABBIT	3114	3106	3037	3480
SQUIRREL	2735	2737	2643	2777
DEER	4908	4899	4810	5260
DOVE	4811	4773	4408	5298
GEESE	6897	6838	6835	7478
TURKEY	7637	7662	7506	7874
FIELD MICE	3367	3329	3223	3795
DEER MICE	5687	5566	5612	6193
MEADOWLARK	5076	4908	4979	5392
MOCKINGBIRD	2392	2400	2326	3055
WOODTHRUSH	6193	6185	6112	6468
FOX	5626	5550	5629	5890
RACCOON	4769	4744	4565	5095
KESTREL	4324	4330	4136	5016
BLACK RACER	5162	5113	5032	6028

0505 RADCLIFFE RIVER

SPECIES	PRES	W/OP	W/P
QUAIL	3089	3128	
RABBIT	3093	3148	
SQUIRREL	3630	3613	
DEER	5625	5638	
DOVE	5580	5487	
GEESE	7465	7505	
TURKEY	7235	7294	
FIELD MICE	3500	3492	
DEER MICE	6965	6929	
MEADOWLARK	5214	5137	
MOCKINGBIRD	2820	2834	
WOODTHRUSH	6570	6559	
FOX	6104	6068	
RACCOON	4982	4954	
KESTREL	3903	3919	
BLACK RACER	6026	6014	

0506 CHURCH HILL BRANCH

SPECIES	PRES	W/OP	W/P
QUAIL	3162	3318	
RABBIT	3128	3340	
SQUIRREL	2491	2529	
DEER	4787	4889	
DOVE	4346	4395	
GEESE	6675	6772	
TURKEY	6688	6824	
FIELD MICE	3779	3996	
DEER MICE	5213	5236	
MEADOWLARK	4735	4935	
MOCKINGBIRD	2718	2783	
WOODTHRUSH	5940	5986	
FOX	5422	5598	
RACCOON	5481	5465	
KESTREL	4184	4325	
BLACK RACER	5113	5223	

0507 GRANNY FINLEY BRANCH

SPECIES	PRES	W/OP	W/P
QUAIL	3908	3986	
RABBIT	3741	3343	
SQUIRREL	2815	2822	
DEER	5192	5195	
DOVE	5168	5162	
GEESE	6568	6578	
TURKEY	7175	7237	
FIELD MICE	4295	4393	
DEER MICE	5771	5764	
MEADOWLARK	5214	5264	
MOCKINGBIRD	3783	3782	
WOODTHRUSH	6458	6432	
FOX	5605	5619	
RACCOON	5610	5557	
KESTREL	4735	4858	
BLACK RACER	5621	5638	

0601 UPPER CHOPTANK

SPECIES	PRES	W/OP	W/P
QUAIL	3010	3061	
RABBIT	2978	3033	
SQUIRREL	2630	2621	
DEER	4586	4615	
DOVE	5093	4995	
GEESE	332	335	
TURKEY	7152	7128	
FIELD MICE	3680	3609	
DEER MICE	5537	5495	
MEADOWLARK	5012	4783	
MOCKINGBIRD	3125	3126	
WOODTHRUSH	5809	5776	
FOX	5134	5045	
RACCOON	4801	4734	
KESTREL	4775	4842	
BLACK RACER	5818	5733	

Table 4 - Wildlife habitat index values.

0602 GOLDSBORO			
SPECIES	PRES	W/OP	W/P
QUAIL	3006	3042	
RABBIT	3333	3289	
SQUIRREL	2364	2372	
DEER	4538	4536	
DOVE	4784	4850	
GEESE	353	353	
TURKEY	7146	7122	
FIELD MICE	3432	3391	
DEER MICE	5007	4990	
MEADOWLARK	4672	4555	
MOCKINGBIRD	2853	2862	
WOODTHRUSH	5550	5531	
FOX	4964	4904	
RACCOON	4601	4581	
KESTREL	4725	4753	
BLACK RACER	5302	5236	

0603 EAST GOLDSBORO				
SPECIES	PRES	W/OP	W/P1	W/P2
QUAIL	3182	3254	3061	3652
RABBIT	3304	3353	3236	4361
SQUIRREL	2450	2447	2313	2470
DEER	4676	4691	4607	5305
DOVE	5068	5133	4647	5909
GEESE	698	692	681	753
TURKEY	6509	6552	6383	6550
FIELD MICE	3965	4014	3917	3553
DEER MICE	4997	4997	4965	5285
MEADOWLARK	5323	5257	5189	4582
MOCKINGBIRD	3074	3077	3013	[illegible]
WOODTHRUSH	5406	5427	[illegible]	[illegible]
FOX	5238	5279	5367	5183
RACCOON	4690	4676	4528	5143
KESTREL	4824	4921	4640	4871
BLACK RACER	5436	5424	5347	5614

0604 FORGE BRANCH				
SPECIES	PRES	W/CP	W/P1	W/P2
QUAIL	3231	3391	3180	3696
RABBIT	3142	3327	3140	3925
SQUIRREL	2224	2232	2164	2423
DEER	4543	4623	4496	5065
DOVE	4538	4604	4381	5738
GEESE	993	1001	995	1124
TURKEY	6675	6772	6626	7193
FIELD MICE	3666	3854	3637	4539
DEER MICE	4844	4872	4846	5613
MEADOWLARK	4638	4808	4630	6009
MOCKINGBIRD	2913	2946	2897	[illegible]
WOODTHRUSH	5745	5770	5713	6434
FOX	5342	5458	5375	6137
RACCOON	4815	4835	4738	5505
KESTREL	4062	4260	4026	5198
BLACK RACER	4893	4988	4894	6027

0605 GARLAND LAKE			
SPECIES	PRES	W/OP	W/P
QUAIL	2691	2720	
RABBIT	3028	3030	
SQUIRREL	2203	2210	
DEER	4278	4283	
DOVE	4645	4723	
GEESE	3465	3502	
TURKEY	6054	6030	
FIELD MICE	3410	3405	
DEER MICE	4434	4407	
MEADOWLARK	4598	4604	
MOCKINGBIRD	2464	2457	
WOODTHRUSH	4871	4848	
FOX	5018	4977	
RACCOON	4251	4237	
KESTREL	3975	4025	
BLACK RACER	5368	5316	

0606 RIDGELY			
SPECIES	PRES	W/OP	W/P
QUAIL	2839	2868	
RABBIT	2928	2956	
SQUIRREL	2989	2983	
DEER	4940	4943	
DOVE	4746	4710	
GEESE	6535	6549	
TURKEY	5614	5622	
FIELD MICE	3104	3113	
DEER MICE	5109	5095	
MEADOWLARK	4358	4298	
MOCKINGBIRD	2781	2782	
WOODTHRUSH	5141	5129	
FOX	4856	4859	
RACCOON	4169	4132	
KESTREL	3776	3797	
BLACK RACER	5307	5281	

0607 WATTS CREEK			
SPECIES	PRES	W/CP	W/P
QUAIL	3062	3208	
RABBIT	2864	3087	
SQUIRREL	2972	2984	
DEER	4774	4825	
DOVE	4747	4857	
GEESE	5319	5463	
TURKEY	6450	6530	
FIELD MICE	3312	3494	
DEER MICE	4789	4843	
MEADOWLARK	4200	4368	
MOCKINGBIRD	3067	3120	
WOODTHRUSH	5581	5594	
FOX	4496	4629	
RACCOON	5062	5040	
KESTREL	4434	4574	
BLACK RACER	4803	4945	

Table 4 – Wildlife habitat index values.

0608 NECK

SPECIES	PRES	W/OP	W/P
QUAIL	4146	4111	
RABBIT	3533	3582	
SQUIRREL	3002	2999	
DEER	4841	4849	
DOVE	4831	4781	
GEESE	0	0	
TURKEY	6805	6845	
FIELD MICE	4224	4259	
DEER MICE	5572	5457	
MEADOWLARK	4165	4981	
MOCKINGBIRD	3886	3767	
WOODTHRUSH	5630	5633	
FOX	5885	5824	
RACCOON	5240	5159	
KESTREL	4240	4368	
BLACK RACER	6057	5871	

0609 WILLISTON

SPECIES	PRES	W/OP	W/P
QUAIL	3559	3727	
RABBIT	3237	3566	
SQUIRREL	2518	2518	
DEER	4823	4883	
DOVE	4976	5156	
GEESE	3084	3287	
TURKEY	6888	7040	
FIELD MICE	3829	4154	
DEER MICE	5224	5266	
MEADOWLARK	3905	4384	
MOCKINGBIRD	3313	3365	
WOODTHRUSH	6347	6342	
FOX	4964	5204	
RACCOON	6144	6126	
KESTREL	4762	4929	
BLACK RACER	5022	5249	

0610 HARMONY

SPECIES	PRES	W/OP	W/P
QUAIL	3077	3128	
RABBIT	3084	3170	
SQUIRREL	1915	1945	
DEER	4211	4265	
DOVE	5432	5510	
GEESE	2311	2348	
TURKEY	6061	6131	
FIELD MICE	3519	3631	
DEER MICE	4361	4372	
MEADOWLARK	4652	4797	
MOCKINGBIRD	3122	3134	
WOODTHRUSH	4997	5016	
FOX	5023	5080	
RACCOON	4977	4999	
KESTREL	4479	4577	
BLACK RACER	4980	5037	

0611 LONG MARSH

SPECIES	PRES	W/OP	W/P
QUAIL	2652	2726	
RABBIT	2882	2836	
SQUIRREL	2636	2630	
DEER	4731	4731	
DOVE	4783	4830	
GEESE	4857	4837	
TURKEY	7018	7055	
FIELD MICE	3284	3295	
DEER MICE	5307	5299	
MEADOWLARK	5291	5116	
MOCKINGBIRD	2413	2416	
WOODTHRUSH	5627	5606	
FOX	5441	5370	
RACCOON	4527	4518	
KESTREL	3984	4050	
BLACK RACER	5515	5455	

0612 GERMANS BRANCH

SPECIES	PRES	W/OP	W/P1	W/P2
QUAIL	3068	3211	2918	3302
RABBIT	3150	3189	3062	3385
SQUIRREL	2333	2323	[illegible]	[illegible]
DEER	4746	4755	4639	5085
DOVE	4735	4822	4381	5251
GEESE	7045	6974	7043	7605
TURKEY	6961	6986	6834	7224
FIELD MICE	3414	3511	3274	3945
DEER MICE	5033	5062	4990	5545
MEADOWLARK	5606	5433	5412	6026
MOCKINGBIRD	2416	2441	2367	2963
WOODTHRUSH	5588	5611	5521	5912
FOX	5441	5435	5423	5888
RACCOON	4796	4824	4623	5160
KESTREL	3866	3935	3727	4690
BLACK RACER	5174	5173	5072	5891

0613 JUMPTOWN

SPECIES	PRES	W/CP	W/P
QUAIL	3272	3301	
RABBIT	3460	3470	
SQUIRREL	2721	2736	
DEER	4932	4952	
DOVE	4875	4901	
GEESE	4769	4784	
TURKEY	6911	6925	
FIELD MICE	3796	3813	
DEER MICE	5825	5818	
MEADOWLARK	4925	4931	
MOCKINGBIRD	2846	2850	
WOODTHRUSH	6163	6172	
FOX	5890	5892	
RACCOON	4855	4855	
KESTREL	4098	4120	
BLACK RACER	6023	6011	

Table 4 - Wildlife habitat index values.

0614 BLACKSTON BRANCH

SPECIES	PRES	W/OP	W/P
QUAIL	3685	3782	
RABBIT	3240	3388	
SQUIRREL	3078	3099	
DEER	5154	5264	
DOVE	5109	5136	
GEESE	6554	6724	
TURKEY	7019	7135	
FIELD MICE	3798	3900	
DEER MICE	5639	5601	
MEADOWLARK	4798	4961	
MOCKINGBIRD	2636	2413	
WOODTHRUSH	6231	6227	
FOX	5953	6003	
RACCOON	5112	5132	
KESTREL	3927	4063	
BLACK RACER	5186	5163	

0615 NORWICK BRANCH

SPECIES	PRES	W/OP	W/P
QUAIL	2007	2103	
RABBIT	2124	2191	
SQUIRREL	2852	2868	
DEER	4747	4808	
DOVE	5116	5154	
GEESE	7116	7166	
TURKEY	7068	7155	
FIELD MICE	2691	2775	
DEER MICE	6262	6237	
MEADOWLARK	5336	5292	
MOCKINGBIRD	2324	2355	
WOODTHRUSH	5815	5835	
FOX	5404	5465	
RACCOON	4256	4215	
KESTREL	4029	4106	
BLACK RACER	5676	5636	

0616 HILLSBORO

SPECIES	PRES	W/OP	W/P
QUAIL	3357	3382	
RABBIT	3119	3112	
SQUIRREL	2438	2453	
DEER	4783	4807	
DOVE	4704	4711	
GEESE	6614	6658	
TURKEY	6769	6792	
FIELD MICE	3335	3335	
DEER MICE	5316	5293	
MEADOWLARK	4646	4604	
MOCKINGBIRD	3060	3052	
WOODTHRUSH	5952	5956	
FOX	5265	5253	
RACCOON	5020	5003	
KESTREL	4017	4028	
BLACK RACER	5095	5032	

0617 TUCKAHOE

SPECIES	PRES	W/OP	W/P
QUAIL	3073	3152	
RABBIT	2838	2976	
SQUIRREL	1628	1644	
DEER	4276	4326	
DOVE	5092	5100	
GEESE	6647	6905	
TURKEY	6811	6909	
FIELD MICE	3560	3717	
DEER MICE	5411	5422	
MEADOWLARK	4625	4815	
MOCKINGBIRD	2772	2791	
WOODTHRUSH	5815	5838	
FOX	5493	5577	
RACCOON	5060	5049	
KESTREL	4102	4210	
BLACK RACER	5314	5408	

0618 LOWER CHOPTANK

SPECIES	PRES	W/OP	W/P1	W/P2
QUAIL	2962	3072	2860	3139
RABBIT	2877	3056	2753	3257
SQUIRREL	3159	3150	3114	3225
DEER	5079	5084	5036	5370
DOVE	5736	5767	5467	6080
GEESE	3154	3216	3092	3349
TURKEY	6677	6780	6583	6902
FIELD MICE	3219	3403	3073	3463
DEER MICE	5259	5279	5217	5654
MEADOWLARK	4523	4621	4319	4755
MOCKINGBIRD	2920	2940	2881	3355
WOODTHRUSH	5843	5811	5832	6088
FOX	5064	5149	4983	5266
RACCOON	5066	4990	5001	5268
KESTREL	4190	4335	4070	4723
BLACK RACER	5267	5388	5116	5629

0619 BETHLEHEM

SPECIES	PRES	W/OP	W/P
QUAIL	2702	2768	
RABBIT	2793	2931	
SQUIRREL	2471	2479	
DEER	4462	4486	
DOVE	5059	5120	
GEESE	2237	2297	
TURKEY	6206	6267	
FIELD MICE	3238	3403	
DEER MICE	4340	4365	
MEADOWLARK	4184	4366	
MOCKINGBIRD	2511	2523	
WOODTHRUSH	5192	5180	
FOX	4744	4851	
RACCOON	4953	4935	
KESTREL	4278	4388	
BLACK RACER	4928	5045	

Table 4 - Wildlife habitat index values.

0620 PRESTON

SPECIES	PRES	W/OP	W/P
QUAIL	3837	3885	
RABBIT	3475	3565	
SQUIRREL	2350	2355	
DEER	4710	4773	
DOVE	4932	4908	
GEESE	2237	2287	
TURKEY	5848	5897	
FIELD MICE	3874	3885	
DEER MICE	4708	4565	
MEADOWLARK	4121	4221	
MOCKINGBIRD	3391	3347	
WOODTHRUSH	5372	5377	
FOX	5148	5193	
RACCOON	4981	4990	
KESTREL	4057	4135	
BLACK RACER	4842	4762	

0621 CABIN CREEK

SPECIES	PRES	W/OP	W/P
QUAIL	2862	2909	
RABBIT	2769	2857	
SQUIRREL	2092	2106	
DEER	4332	4358	
DOVE	4847	4861	
GEESE	2192	2260	
TURKEY	5907	5953	
FIELD MICE	3351	3438	
DEER MICE	4481	4485	
MEADOWLARK	4192	4301	
MOCKINGBIRD	2557	2566	
WOODTHRUSH	5159	5197	
FOX	5061	5138	
RACCOON	4827	4809	
KESTREL	3981	4045	
BLACK RACER	4843	4989	

0622 WARWICK RIVER

SPECIES	PRES	W/CP	W/P
QUAIL	3378	3954	
RABBIT	0	3188	
SQUIRREL	2879	3004	
DEER	4983	5287	
DOVE	3920	4929	
GEESE	1949	2331	
TURKEY	5740	6296	
FIELD MICE	2559	3129	
DEER MICE	0	4718	
MEADOWLARK	3166	3974	
MOCKINGBIRD	2462	3234	
WOODTHRUSH	[illegible]	6016	
FOX	3663	4731	
RACCOON	5097	5166	
KESTREL	3262	3607	
BLACK RACER	2182	4171	

0701 UPPER NANTICOKE

SPECIES	PRES	W/OP	W/P
QUAIL	3102	3144	
RABBIT	3223	3253	
SQUIRREL	2395	2392	
DEER	4524	4530	
DOVE	5382	5406	
GEESE	309	316	
TURKEY	6209	6217	
FIELD MICE	3395	3402	
DEER MICE	4656	4625	
MEADOWLARK	4602	4644	
MOCKINGBIRD	3343	3333	
WOODTHRUSH	5494	5463	
FOX	4735	4711	
RACCOON	4685	4648	
KESTREL	4508	4579	
BLACK RACER	5762	5711	

0702 MIDDLE NANTICOKE

SPECIES	PRES	W/OP	W/P
QUAIL	2769	2896	
RABBIT	3021	3175	
SQUIRREL	2178	2185	
DEER	4448	4478	
DOVE	4814	5047	
GEESE	429	443	
TURKEY	5493	5567	
FIELD MICE	3221	3433	
DEER MICE	3957	3959	
MEADOWLARK	4013	4383	
MOCKINGBIRD	3008	3046	
WOODTHRUSH	4951	4932	
FOX	4562	4664	
RACCOON	4567	4578	
KESTREL	3939	4141	
BLACK RACER	5104	5204	

0703 BROAD CREEK

SPECIES	PRES	W/CP	W/P1	W/P2
QUAIL	3153	3188	3120	3447
RABBIT	3404	3451	3424	3774
SQUIRREL	1972	1968	1944	2170
DEER	4374	4377	4395	4740
DOVE	5122	5112	4983	5609
GEESE	300	305	303	338
TURKEY	5074	5099	5089	5455
FIELD MICE	3616	3654	3677	3985
DEER MICE	3602	3585	3617	4067
MEADOWLARK	4395	4475	4453	4868
MOCKINGBIRD	3222	3213	3214	3694
WOODTHRUSH	4681	4656	4690	5121
FOX	4583	4557	4645	4809
RACCOON	4594	4549	4562	4982
KESTREL	4304	4385	4340	5017
BLACK RACER	5171	5164	5203	5692

Table 4 – Wildlife habitat index values.

0704 SHARPTOWN

SPECIES	PRES	W/OP	W/P
QUAIL	3108	3129	
RABBIT	3573	3559	
SQUIRREL	1643	1649	
DEER	4416	4410	
DOVE	5013	5045	
GEESE	1543	1651	
TURKEY	5448	5445	
FIELD MICE	3450	3427	
DEER MICE	4241	4215	
MEADOWLARK	3845	3991	
MOCKINGBIRD	3632	3615	
WOODTHRUSH	5174	5151	
FOX	4682	4608	
RACCOON	4622	4603	
KESTREL	4648	4718	
BLACK RACER	5860	5785	

0705 MARSHYHOPE

SPECIES	PRES	W/OP	W/P
QUAIL	3570	3614	
RABBIT	3804	3835	
SQUIRREL	2267	2266	
DEER	4559	4580	
DOVE	4945	5075	
GEESE	1970	2045	
TURKEY	6323	6358	
FIELD MICE	4234	4250	
DEER MICE	4621	4584	
MEADOWLARK	4652	4306	
MOCKINGBIRD	3307	3282	
WOODTHRUSH	5706	5663	
FOX	5237	5197	
RACCOON	5115	5108	
KESTREL	4744	4862	
BLACK RACER	5802	5738	

0706 LOWER MARSHYHOPE

SPECIES	PRES	W/OP	W/P1	W/P2
QUAIL	2619	2666	2566	2857
RABBIT	2674	2760	2682	2974
SQUIRREL	2246	2242	2165	2397
DEER	4484	4509	4455	4794
DOVE	5292	5354	5036	5614
GEESE	1446	1502	1441	1564
TURKEY	6018	6086	5961	6309
FIELD MICE	3109	3123	3161	3307
DEER MICE	4588	4521	4625	5101
MEADOWLARK	4577	4787	4596	4955
MOCKINGBIRD	3155	3108	3150	3765
WOODTHRUSH	5816	5764	5609	6279
FOX	4740	4681	4888	4898
RACCOON	4717	4705	4527	4965
KESTREL	4317	4432	4242	4855
BLACK RACER	5698	5577	5813	6076

0707 LOWER NANTICOKE

SPECIES	PRES	W/OP	W/P1	W/P2
QUAIL	181	186	179	258
RABBIT	646	680	637	696
SQUIRREL	884	886	874	1075
DEER	1766	1738	1776	2148
DOVE	4615	4462	4560	4805
GEESE	2304	2234	234	236
TURKEY	4351	4349	4361	4770
FIELD MICE	786	807	774	831
DEER MICE	1326	1330	1322	2043
MEADOWLARK	3103	2921	3156	3156
MOCKINGBIRD	118	119	117	243
WOODTHRUSH	1912	1899	1912	2414
FOX	2892	2825	2953	2964
RACCOON	2252	2194	2241	2317
KESTREL	2394	2329	2386	2863
BLACK RACER	3666	3741	3636	3929

0708 BARREN CREEK

SPECIES	PRES	W/OP	W/P1	W/P2
QUAIL	1259	1292	1222	1473
RABBIT	1907	1965	1869	2136
SQUIRREL	1372	1374	1348	1505
DEER	3242	3244	3224	3603
DOVE	5136	5132	4833	5423
GEESE	2182	2237	2153	2355
TURKEY	5279	5295	5252	5562
FIELD MICE	2305	2368	2249	2552
DEER MICE	3079	3086	3063	3805
MEADOWLARK	3918	3941	3856	4113
MOCKINGBIRD	1135	1148	1115	1598
WOODTHRUSH	3711	3703	3712	4214
FOX	4186	4212	4169	4378
RACCOON	3658	3621	3611	3922
KESTREL	4126	4218	4026	4668
BLACK RACER	4752	4825	4646	5280

0709 REWASTICO CREEK

SPECIES	PRES	W/OP	W/P1	W/P2
QUAIL	2295	2348	2262	2453
RABBIT	2610	2721	2568	2709
SQUIRREL	1801	1802	1790	1880
DEER	3920	3925	3919	4233
DOVE	5486	5491	5369	5656
GEESE	1086	1156	1056	1190
TURKEY	5636	5656	5633	5792
FIELD MICE	2680	2785	2645	2840
DEER MICE	3590	3567	3593	3990
MEADOWLARK	3919	4172	3831	4393
MOCKINGBIRD	2280	2274	2271	2789
WOODTHRUSH	5129	5088	5138	5390
FOX	4216	4218	4228	4182
RACCOON	4933	4870	4921	5108
KESTREL	3983	4136	3930	4562
BLACK RACER	5397	5402	5386	5239

Table 4 - Wildlife habitat index values.

0710 QUANTICO CREEK

SPECIES	PRES	W/OP	W/P
QUAIL	1369	1401	
RABBIT	1756	1809	
SQUIRREL	1631	1628	
DEER	3393	3358	
DOVE	5315	5176	
GEESE	1019	1038	
TURKEY	5351	5350	
FIELD MICE	1779	1814	
DEER MICE	3196	3197	
MEADOWLARK	3809	3766	
MOCKINGBIRD	1492	1500	
WOODTHRUSH	4342	4326	
FOX	3511	3507	
RACCOON	3955	3881	
KESTREL	3537	3580	
BLACK RACER	4836	4891	

0711 WETIPQUIN CREEK

SPECIES	PRES	W/OP	W/P1	W/P2
QUAIL	2236	2278	2236	2346
RABBIT	2141	2222	2141	2323
SQUIRREL	1971	1973	1971	1974
DEER	3920	3843	3920	4204
DOVE	4983	4772	4983	5250
GEESE	1004	1011	1004	1066
TURKEY	5501	5470	5501	5655
FIELD MICE	2059	2068	2059	2094
DEER MICE	4324	4307	4324	4612
MEADOWLARK	3421	3281	3421	3590
MOCKINGBIRD	3481	3491	3481	3851
WOODTHRUSH	5232	5205	5232	[illegible]
FOX	3264	3246	3264	3345
RACCOON	4489	4336	4489	4670
KESTREL	4613	4533	4613	4999
BLACK RACER	4587	4614	4587	4808

0801 UPPER POCOMOKE

SPECIES	PRES	W/OP	W/P1	W/P2
QUAIL	2157	2167	2145	2343
RABBIT	2644	2700	2655	2857
SQUIRREL	1463	1446	1422	1558
DEER	3818	3811	3822	4179
DOVE	5922	5780	5786	5904
GEESE	300	332	299	333
TURKEY	5259	5278	5265	5567
FIELD MICE	3020	3010	3021	3102
DEER MICE	3314	3252	3319	3726
MEADOWLARK	4761	5017	4713	[illegible]
MOCKINGBIRD	2334	2267	2341	2895
WOODTHRUSH	4689	4600	[illegible]	[illegible]
FOX	4584	4431	4539	4591
RACCOON	4473	4351	[illegible]	4631
KESTREL	4416	4610	4383	4893
BLACK RACER	5972	5871	5970	6272

0802 GREEN RUN

SPECIES	PRES	W/OP	W/P1	W/P2
QUAIL	3638	3811	3597	3736
RABBIT	3207	3541	3233	3689
SQUIRREL	1843	1814	1813	1932
DEER	4446	4506	4438	4782
DOVE	5523	5454	5375	5992
GEESE	316	335	318	351
TURKEY	5310	5505	5306	5710
FIELD MICE	3809	4152	3785	4306
DEER MICE	4173	4133	4167	4673
MEADOWLARK	4355	4845	4330	5213
MOCKINGBIRD	3374	3338	3357	3844
WOODTHRUSH	5225	5147	5212	5530
FOX	4997	5034	5013	5386
RACCOON	4930	4845	4878	5240
KESTREL	4167	4695	4138	4998
BLACK RACER	5116	5185	5112	5956

0803 MIDDLE POCOMOKE

SPECIES	PRES	W/OP	W/P1	W/P2
QUAIL	2390	2437	2385	2593
RABBIT	2777	2801	2775	2985
SQUIRREL	1958	1939	1958	2083
DEER	4002	3950	4017	4331
DOVE	5718	5547	5679	5863
GEESE	575	582	572	612
TURKEY	5910	5911	5915	6190
FIELD MICE	2642	2649	2642	2784
DEER MICE	4010	3975	4022	4568
MEADOWLARK	4139	4155	4066	4319
MOCKINGBIRD	2513	2509	2513	3148
WOODTHRUSH	5375	5329	5392	5801
FOX	4227	4139	4266	4301
RACCOON	4706	4598	4704	4896
KESTREL	4133	4221	4100	4661
BLACK RACER	5947	5876	5969	6321

0804 AYDELOTTE

SPECIES	PRES	W/OP	W/P
QUAIL	3734	3952	
RABBIT	3405	3761	
SQUIRREL	2717	2679	
DEER	4982	5056	
DOVE	5924	5845	
GEESE	332	339	
TURKEY	5387	5509	
FIELD MICE	3766	4110	
DEER MICE	4352	4366	
MEADOWLARK	4438	4677	
MOCKINGBIRD	3719	3737	
WOODTHRUSH	5356	5286	
FOX	4702	4766	
RACCOON	5052	4977	
KESTREL	4541	5042	
BLACK RACER	5166	5354	

Table 4 - Wildlife habitat index values.

08D5 FRANKLIN BRANCH

SPECIES	PRES	W/OP	W/P
QUAIL	2390	2508	
RABBIT	2301	2423	
SQUIRREL	2242	2228	
DEER	4143	4107	
DOVE	5495	5185	
GEESE	695	683	
TURKEY	5700	5771	
FIELD MICE	2332	2465	
DEER MICE	4392	4407	
MEADOWLARK	3613	3691	
MOCKINGBIRD	2732	2808	
WOODTHRUSH	5346	5331	
FOX	3748	3806	
RACCOON	4007	3873	
KESTREL	4235	4477	
BLACK RACER	4568	4735	

08D6 POWELLVILLE

SPECIES	PRES	W/OP	W/P
QUAIL	2194	2362	
RABBIT	2258	2511	
SQUIRREL	1984	1968	
DEER	3949	3972	
DOVE	5399	5313	
GEESE	2551	2543	
TURKEY	5686	5759	
FIELD MICE	2343	2633	
DEER MICE	4121	4184	
MEADOWLARK	3891	4112	
MOCKINGBIRD	2712	2764	
WOODTHRUSH	5192	5170	
FOX	3756	3739	
RACCOON	4250	4230	
KESTREL	3918	4294	
BLACK RACER	4987	5229	

0807 TIMMONSTOWN

SPECIES	PRES	W/OP	W/P
QUAIL	3154	3251	
RABBIT	3073	3174	
SQUIRREL	1848	1828	
DEER	4262	4228	
DOVE	6003	5747	
GEESE	704	697	
TURKEY	5954	5953	
FIELD MICE	3466	3569	
DEER MICE	4782	4600	
MEADOWLARK	4611	4548	
MOCKINGBIRD	2912	2920	
WOODTHRUSH	5261	5219	
FOX	4641	4613	
RACCOON	4832	4743	
KESTREL	4647	4838	
BLACK RACER	5740	5862	

08D8 NINEPIN

SPECIES	PRES	W/OP	W/P
QUAIL	2696	2772	
RABBIT	2444	2535	
SQUIRREL	1484	1467	
DEER	3873	3815	
DOVE	5044	4696	
GEESE	690	687	
TURKEY	5903	5934	
FIELD MICE	2118	2160	
DEER MICE	4071	4045	
MEADOWLARK	3596	3618	
MOCKINGBIRD	1900	1917	
WOODTHRUSH	5174	5144	
FOX	3848	3824	
RACCOON	4269	4109	
KESTREL	3886	4018	
BLACK RACER	4431	4452	

08D9 CCCNFCCT

SPECIES	PRES	W/OP	W/P
QUAIL	4668	4749	
RABBIT	4449	4441	
SQUIRREL	1847	1860	
DEER	4662	4663	
DOVE	6374	6327	
GEESE	552	624	
TURKEY	5957	5943	
FIELD MICE	4871	4766	
DEER MICE	4827	4787	
MEADOWLARK	4985	5024	
MOCKINGBIRD	3449	3440	
WOODTHRUSH	5712	5652	
FOX	5531	5334	
RACCOON	5902	5843	
KESTREL	5218	5361	
BLACK RACER	6495	6460	

081D NASSAWANGO

SPECIES	PRES	W/OP	W/P
QUAIL	1108	1117	1103
RABBIT	1602	1599	1604
SQUIRREL	1404	1399	1393
DEER	3004	2960	3075
DOVE	5134	5060	5068
GEESE	510	536	516
TURKEY	5607	5573	5618
FIELD MICE	1376	1374	1389
DEER MICE	3484	3459	3488
MEADOWLARK	3323	3467	3343
MOCKINGBIRD	1899	1894	1893
WOODTHRUSH	5024	4972	5033
FOX	3218	3169	3258
RACCOON	3542	3447	3548
KESTREL	3445	3486	3466
BLACK RACER	6081	5999	6069

Table 4 - Wildlife habitat index values.

0811	DIVIDING CREEK		
SPECIES	PRES	W/OP	W/P
QUAIL	1614	1614	
RABBIT	2078	2065	
SQUIRREL	1408	1393	
DEER	0	0	
DOVE	5244	4969	
GEESE	515	510	
TURKEY	5752	5611	
FIELD MICE	1696	1656	
DEER MICE	3926	3882	
MEADOWLARK	3435	3276	
MOCKINGBIRD	2452	2435	
WOODTHRUSH	5259	5176	
FOX	3318	3220	
RACCOON	3960	3808	
KESTREL	3659	3604	
BLACK RACER	6303	6174	

0812	BLACKDAM		
SPECIES	PRES	W/OP	W/P
QUAIL	3084	3211	
RABBIT	3069	3289	
SQUIRREL	1981	1993	
DEER	4288	4319	
DOVE	5086	5025	
GEESE	639	653	
TURKEY	6049	6064	
FIELD MICE	3343	3446	
DEER MICE	4281	4263	
MEADOWLARK	4096	4257	
MOCKINGBIRD	3065	3075	
WOODTHRUSH	5289	5241	
FOX	4539	4573	
RACCOON	4813	4724	
KESTREL	4288	4471	
BLACK RACER	5304	5368	

0813	LOWER POCOMOKE		
SPECIES	PRES	W/OP	W/P
QUAIL	271	284	
RABBIT	779	824	
SQUIRREL	1010	1008	
DEER	2027	2022	
DOVE	4864	4914	
GEESE	655	673	
TURKEY	4870	4907	
FIELD MICE	1154	1261	
DEER MICE	2039	2061	
MEADOWLARK	3534	3648	
MOCKINGBIRD	254	262	
WOODTHRUSH	2200	2196	
FOX	3728	3845	
RACCOON	2170	2143	
KESTREL	3081	3177	
BLACK RACER	4377	4577	

0814	REHOBETH BRANCH		
SPECIES	PRES	W/OP	W/P
QUAIL	3139	3215	
RABBIT	3514	3481	
SQUIRREL	1706	1717	
DEER	4225	4155	
DOVE	5005	4842	
GEESE	674	660	
TURKEY	5998	5965	
FIELD MICE	3248	3157	
DEER MICE	4366	4349	
MEADOWLARK	4183	3919	
MOCKINGBIRD	3255	3296	
WOODTHRUSH	5234	5210	
FOX	4483	4320	
RACCOON	4726	4610	
KESTREL	4504	4493	
BLACK RACER	5828	5773	

0901	JOHNSON LAKE			
SPECIES	PRES	W/OP	W/P1	W/P2
QUAIL	2353	2474	2212	2699
RABBIT	2524	2702	2508	3119
SQUIRREL	2760	2753	2589	2900
DEER	4557	4596	4530	5041
DOVE	4823	4954	4197	5525
GEESE	306	312	313	358
TURKEY	4749	4788	4781	5106
FIELD MICE	2912	3071	2970	3317
DEER MICE	3863	3886	3860	4312
MEADOWLARK	4010	4206	4043	4717
MOCKINGBIRD	2803	2824	2757	3324
WOODTHRUSH	4571	4546	4593	4883
FOX	4086	4185	4256	4527
RACCOON	4059	4038	3879	4367
KESTREL	4045	4246	3974	4831
BLACK RACER	4839	4959	4810	5504

0902	BEAVER DAM		
SPECIES	PRES	W/OP	W/P
QUAIL	3068	3126	
RABBIT	3173	3247	
SQUIRREL	3284	3279	
DEER	4993	5012	
DOVE	5636	5503	
GEESE	319	325	
TURKEY	5347	5357	
FIELD MICE	3574	3557	
DEER MICE	4430	4409	
MEADOWLARK	4372	4295	
MOCKINGBIRD	3348	3352	
WOODTHRUSH	5024	4997	
FOX	4391	4343	
RACCOON	4531	4463	
KESTREL	4716	4823	
BLACK RACER	5445	5425	

Table 4 - Wildlife habitat index values.

0903 PEMBERTON

SPECIES	PRES	W/OP	W/P
QUAIL	4739	4760	
RABBIT	4249	4324	
SQUIRREL	3518	3519	
DEER	5460	5513	
DOVE	5893	5890	
GEESE	476	504	
TURKEY	6272	6312	
FIELD MICE	4726	4725	
DEER MICE	5355	5331	
MEADOWLARK	4321	4429	
MOCKINGBIRD	4327	4311	
WOODTHRUSH	6015	5996	
FOX	5491	5481	
RACCOON	5517	5503	
KESTREL	4624	4682	
BLACK RACER	5674	5647	

0904 TONY TANK

SPECIES	PRES	W/OP	W/P
QUAIL	3141	3204	
RABBIT	3017	3182	
SQUIRREL	3138	3130	
DEER	4937	5003	
DOVE	5904	5794	
GEESE	375	394	
TURKEY	5575	5608	
FIELD MICE	3602	3623	
DEER MICE	4558	4505	
MEADOWLARK	4299	4461	
MOCKINGBIRD	3592	3548	
WOODTHRUSH	5184	5139	
FOX	4441	4439	
RACCOON	4804	4717	
KESTREL	4669	4832	
BLACK RACER	5374	5325	

0905 SILOAM

SPECIES	PRES	W/OP	W/P
QUAIL	2580	2622	
RABBIT	2578	2651	
SQUIRREL	1999	2005	
DEER	4278	4272	
DOVE	5491	5446	
GEESE	666	681	
TURKEY	5517	5521	
FIELD MICE	2834	2891	
DEER MICE	4568	4547	
MEADOWLARK	4228	4342	
MOCKINGBIRD	3032	3028	
WOODTHRUSH	5154	5125	
FOX	4389	4399	
RACCOON	4556	4481	
KESTREL	4297	4395	
BLACK RACER	5470	5501	

0906 PASSERDYKE CREEK

SPECIES	PRES	W/OP	W/P
QUAIL	3161	3253	
RABBIT	3260	3356	
SQUIRREL	1864	1874	
DEER	4233	4181	
DOVE	5335	5266	
GEESE	620	630	
TURKEY	5293	5277	
FIELD MICE	3294	3337	
DEER MICE	4186	4151	
MEADOWLARK	3916	4038	
MOCKINGBIRD	3333	3336	
WOODTHRUSH	5098	5053	
FOX	4380	4314	
RACCOON	4956	4844	
KESTREL	4300	4491	
BLACK RACER	6042	5978	

0907 UPPER WICOMICO

SPECIES	PRES	W/OP	W/P
QUAIL	520	539	
RABBIT	960	999	
SQUIRREL	1135	1132	
DEER	2475	2450	
DOVE	4739	4692	
GEESE	643	633	
TURKEY	4504	4440	
FIELD MICE	863	902	
DEER MICE	2237	2256	
MEADOWLARK	3086	3005	
MOCKINGBIRD	603	615	
WOODTHRUSH	2993	2961	
FOX	2463	2476	
RACCOON	2833	2763	
KESTREL	2827	2823	
BLACK RACER	3965	4103	

0908 LOWER WICOMICO

SPECIES	PRES	W/OP	W/P
QUAIL	840	855	
RABBIT	1440	1469	
SQUIRREL	1275	1274	
DEER	2807	2776	
DOVE	4933	4791	
GEESE	612	607	
TURKEY	4941	4923	
FIELD MICE	1393	1396	
DEER MICE	2681	2681	
MEADOWLARK	3338	3234	
MOCKINGBIRD	937	944	
WOODTHRUSH	3607	3568	
FOX	3103	3064	
RACCOON	3443	3360	
KESTREL	3321	3282	
BLACK RACER	4689	4738	

Table 4 - Wildlife habitat index values.

1001 UPPER CHICACOMICC

SPECIES	PRES	W/OP	W/P
QUAIL	3561	3546	
RABBIT	3386	3360	
SQUIRREL	1267	1266	
DEER	4163	4143	
DOVE	5121	4991	
GEESE	2400	2380	
TURKEY	6518	6482	
FIELD MICE	3966	3756	
DEER MICE	5226	5103	
MEADOWLARK	5078	4783	
MOCKINGBIRD	3602	3496	
WOODTHRUSH	6310	6222	
FOX	5150	4874	
RACCOON	5365	5296	
KESTREL	4703	4718	
BLACK RACER	6017	5726	

1002 CHICACOMICO RIVER

SPECIES	PRES	W/OP	W/P
QUAIL	2047	2177	
RABBIT	2006	2211	
SQUIRREL	1240	1238	
DEER	3714	3734	
DOVE	4791	4848	
GEESE	2169	2315	
TURKEY	5996	6066	
FIELD MICE	2149	2339	
DEER MICE	4200	4237	
MEADOWLARK	4086	4274	
MOCKINGBIRD	2082	2127	
WOODTHRUSH	5240	5224	
FOX	4027	4182	
RACCOON	4478	4415	
KESTREL	3690	3842	
BLACK RACER	4726	4959	

1003 FISHING BAY

SPECIES	PRES	W/OP	W/P
QUAIL	33	34	
RABBIT	165	162	
SQUIRREL	234	234	
DEER	926	918	
DOVE	3390	3371	
GEESE	1727	1683	
TURKEY	2513	2483	
FIELD MICE	107	105	
DEER MICE	880	883	
MEADOWLARK	1543	1518	
MOCKINGBIRD	54	55	
WOODTHRUSH	1119	1115	
FOX	886	864	
RACCOON	902	889	
KESTREL	1269	1261	
BLACK RACER	2622	2629	

1004 TRANSQUAKING RIVER

SPECIES	PRES	W/OP	W/P
QUAIL	2401	2483	
RABBIT	2571	2694	
SQUIRREL	1934	1969	
DEER	4228	4231	
DOVE	5727	5661	
GEESE	2348	2430	
TURKEY	6532	6574	
FIELD MICE	2969	3040	
DEER MICE	4752	4738	
MEADOWLARK	4870	4860	
MOCKINGBIRD	2348	2357	
WOODTHRUSH	5413	5374	
FOX	4706	4698	
RACCOON	4790	4712	
KESTREL	4466	4601	
BLACK RACER	5569	5627	

1005 MIDDLETOWN BRANCH

SPECIES	PRES	W/OP	W/P
QUAIL	3992	4132	3879
RABBIT	3390	3702	3348
SQUIRREL	1417	1435	1395
DEER	4368	4346	4272
DOVE	5789	5473	5621
GEESE	2133	2285	2099
TURKEY	6844	6765	6710
FIELD MICE	4323	4053	4224
DEER MICE	5740	5595	5710
MEADOWLARK	5517	5120	5336
MOCKINGBIRD	4617	4511	4413
WOODTHRUSH	6466	6356	6387
FOX	5531	5222	5365
RACCOON	5514	5370	5462
KESTREL	5174	5164	5045
BLACK RACER	7045	6713	6821

1006 LITTLE BLACKWATER

SPECIES	PRES	W/OP	W/P1	W/P2
QUAIL	1592	1657	1561	1700
RABBIT	1812	1927	1765	1946
SQUIRREL	1517	1510	1521	1573
DEER	3579	3561	3571	3842
DOVE	5433	5279	5326	5540
GEESE	2311	2444	2278	2419
TURKEY	5915	5953	5888	61
FIELD MICE	1943	2014	1873	2015
DEER MICE	4335	4341	4312	4831
MEADOWLARK	4169	4176	4032	4276
MOCKINGBIRD	2018	2038	2005	2401
WOODTHRUSH	4940	4908	4945	5272
FOX	3880	3871	3835	3969
RACCOON	3972	3876	3969	4091
KESTREL	3939	3987	3773	4268
BLACK RACER	5245	5399	5136	5645

Table 4 - Wildlife habitat index values.

1007	BLACKWATEP RIVER	
QUAIL	420	426
RABBIT	831	839
SQUIRREL	910	901
DEER	2227	2162
COVE	4479	4215
GEESE	1940	1868
TUPKEY	4319	4151
FIELC MICE	613	606
CEER MICE	1924	1913
MEADCWLAPK	2716	2476
MOCKINGBIRD	655	655
WOODTHRUSH	3059	2993
FOX	1954	1893
RACCCON	2471	2337
KESTREL	2736	2654
BLACK FACER	4074	4033

COMPETING LAND USE PRIORITIES ON THE DELMARVA PENINSULA

APPENDIX D

FOREWORD

The Delmarva River Basins Survey developed and applied a systematic evaluation procedure to identify and compare land use priorities. Three major priority groupings were mapped by modified grids using criteria identified by agriculture, forestry and urban priority committees (work groups). Weights were applied and priority scores generated. Subsequent evaluation of the scores identified the degree of conflicts between each major priority grouping by identifying the relative importance of each score. Five levels of conflicts were defined ranging from extreme to none. Maps were then developed displaying the general geographic patterns resulting from interpretation of the five conflict levels.

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INTRODUCTION

Agricultural drainage needs, benefits, and impacts have been the concern of federal and state agencies participating in the Delmarva River Basins Cooperative Survey. These agencies have attempted to consider both the economic and environmental aspects of altering drainage regimes on 109 watersheds that encompass the entire Peninsula (Figure 1). The ultimate objective of this study was to identify watersheds where detailed planning for drainage improvement is justified on the basis of benefits for crop production and to select for action those where adverse environmental impacts could be minimized or avoided.

Based on local interest and a traditional benefit-cost analysis, a number of the Peninsula's watersheds have been identified where drainage projects could be justified for agricultural purposes. The concern for environmental quality has been addressed through an intensive analysis of wildlife habitat and the identification of additional environmental amenities including endangered species habitats. Environmental issues raise caveats in the watershed selection process as well as guidance in the detailed planning which might follow on selected watersheds.

In addition to these comprehensive efforts, an evaluation has been made of the Peninsula's resources from the perspective of major land use alternatives. This appendix describes this evaluation, based on existing data descriptive of the resource base, which was designed during the course of the survey to identify and compare the land use priorities of concerned state and federal agencies. Maps of three priorities--agriculture, forestry, and urban development--were prepared and then compared to provide supplemental information and to establish a basis for anticipating where competition

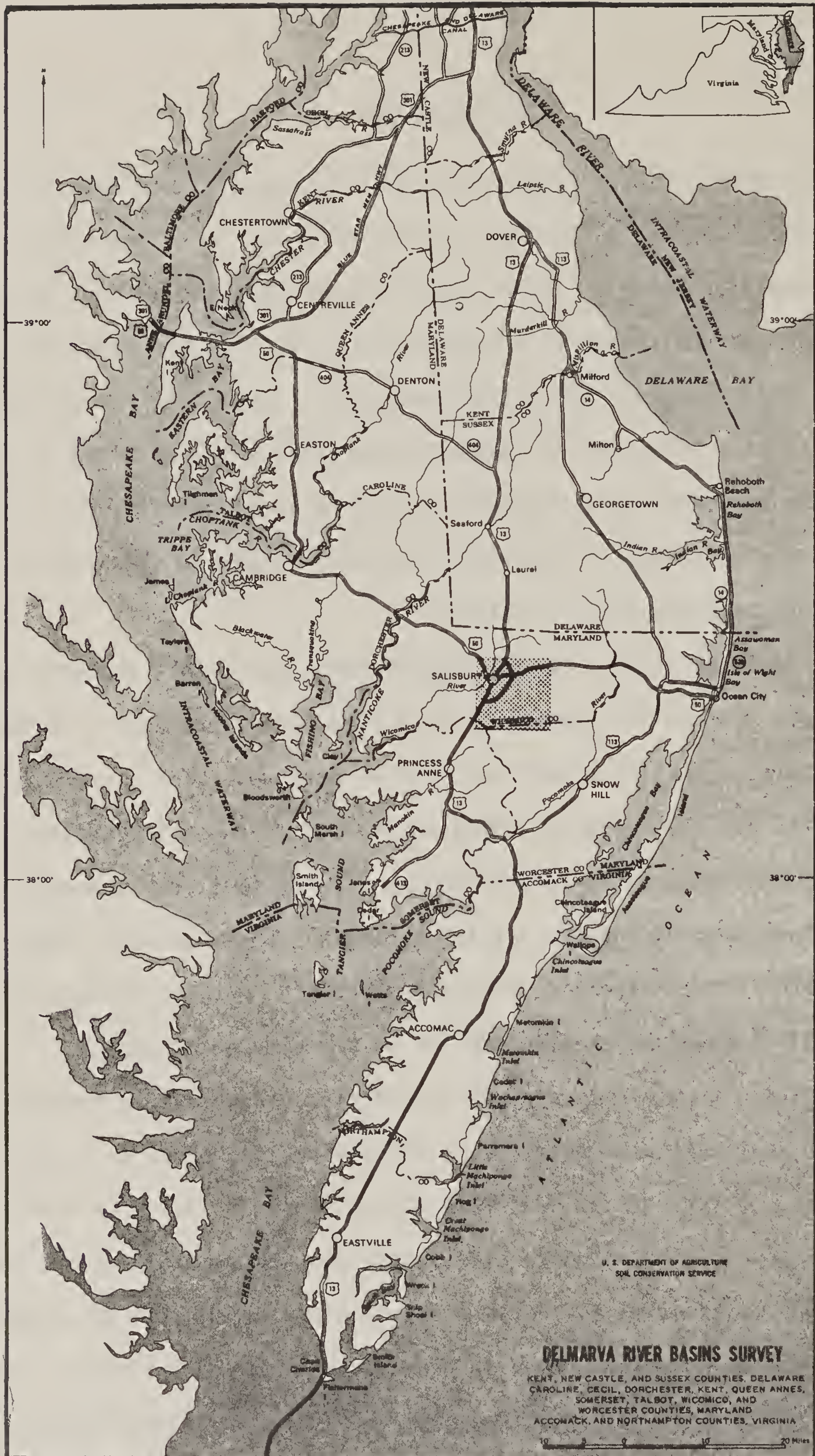

Figure 1--Map of the Delmarva Peninsula
(Stippled area is the locality shown in greater detail in Figure 3.)

among these three land uses is likely to be most intense and may be most sensitive to external influences.

MODIFIED GRID DATA BASE

The evaluation of land from agricultural, forestry, and urban development perspectives required that comparisons be made among all areas of the Peninsula. Qualitative and quantitative descriptors were developed to provide a uniform and objective basis for generalized judgments made in analyzing land use priorities and to satisfy the more comprehensive data requirements of the river basin survey.

The most common and useful form of available data describing the Peninsula's soils and current land uses were maps which presented succinct visual summaries of the distribution of these important variables. To facilitate the comparison and evaluation of these data, as well as others which were subsequently needed, a grid was used to divide the Peninsula into subareas. Once defined, these subareas translated maps into units of land for which qualitative and quantitative variables were collected and coded for computer processing.

Ordinarily the type of grid used to code maps is uniform in size, rectangular in shape, and relatively fine in terms of the area covered by each grid cell. Normally, only the dominant attribute of each cell is coded. Because of the expense anticipated to code maps for several variables for the entire Peninsula, the grid actually prepared was a modification of this standard grid concept.

Economic criteria were the basis for the intuitive decision to accept a relatively course grid which encompassed several square miles per cell. Although the benefits of information derived by reducing the grid cell

size would clearly increase in a linear manner or increase at a decreasing rate, the cost of coding and processing data for finer grids would increase exponentially. If these costs and benefits could be reduced to comparable measured terms, the grid cell size at which they became equal would define the smallest economically feasible grid cell size. Unfortunately, budget constraints seldom support even the choice of a somewhat coarser grid justified by the relationship of marginal benefits and marginal costs. Budget and personnel constraints therefore required that the grid be relatively coarse.

Two additional modifications were employed. One allowed the grid cells to become non-uniform in size. Larger cells were adequate where land use and soils were homogeneous, but smaller cells were more appropriate where land use covered a wider range of categories or where soils were heterogeneous in character. Finally the constraint of rectangularity was dropped. Grid cell boundaries were allowed to follow the road and river network to facilitate the delineation of the same subareas among maps and to relate mapped areas to actual tracts of land.

The conceptual design for the modified grid was implemented for each county to permit the preparation of summaries for important political units. Initially, census enumeration districts, which are also delineated along road and river boundaries, were used to disaggregate county areas and to define urban places. Modified grid cells (MGC) were then delineated within each enumeration district by examining primarily the variations in soils with some adjustments to account for greater variety in land uses. The number of subareas which may be addressed at each level of this hierarchical scheme are summarized in Table 1.

Table 1 -- Subareas established for Delmarva River Basins Survey

State (code)	County (code)	Number of Census Enumeration Districts (CED)		Number of Modified Grid Cells (MGC)	
Delaware (1)	New Castle* (1)	10		92	
	Kent (2)	77		212	
	Sussex (3)	130		260	
Subtotal			217		564
Maryland (2)	Cecil* (1)	7		34	
	Kent (2)	21		102	
	Queen Annes (3)	26		139	
	Caroline (4)	29		116	
	Talbot (5)	33		112	
	Dorchester (6)	46		157	
	Wicomico (7)	74		148	
	Worcester (8)	32		118	
	Somerset (9)	28		90	
Subtotal			296		1016
Virginia (3)	Accomack (1)	42		73	
	Northampton (2)	22		43	
Subtotal			64		116
TOTAL			577		1696

* Only areas south of the Chesapeake and Delaware Canal are included for these counties.

For the entire Peninsula 1,696 cells were established. Of these, 169 were designated as urban places. Cells ranged in size from 51 to 16,960 acres with an average size of 2,278 acres. For each MGC a five-digit address was established to indicate State, County and cell number. Figure 2 shows the location of cells for Wicomico County (7), Maryland (2). Figure 3 illustrates, in greater detail, an area near Salisbury, Maryland. Similar maps for all 14 counties are available as ammonia prints at a scale of approximately 1 inch = 1 mile.

Two principal types of coding were employed for the variety of data collected (Table 2). Nominal coding--to indicate the presence or absence of an attribute in a given MGC--was used to code such variables as specialty crops or sewer service areas. For land use and soil variables, estimates of actual areas were made by dot counts so that the area or proportion of each variable could be calculated for each cell. When dot counting was employed, one point for every 25.6 acres was employed on maps of all scales.

Summaries are presented here for land use (Table 3) and soils (Table 4) for the entire Peninsula. Similar estimates can be prepared for County and State areas covered by the survey as well as for individual modified grid cells or aggregates of these which might cross political subdivisions.

EVALUATION OF PRIORITIES

To evaluate the Peninsula's resources from each of three perspectives, representatives of state and federal agencies formed three committees based on agency interests and concerns. The task of each committee was to select criteria which reflected the subjective qualities important to

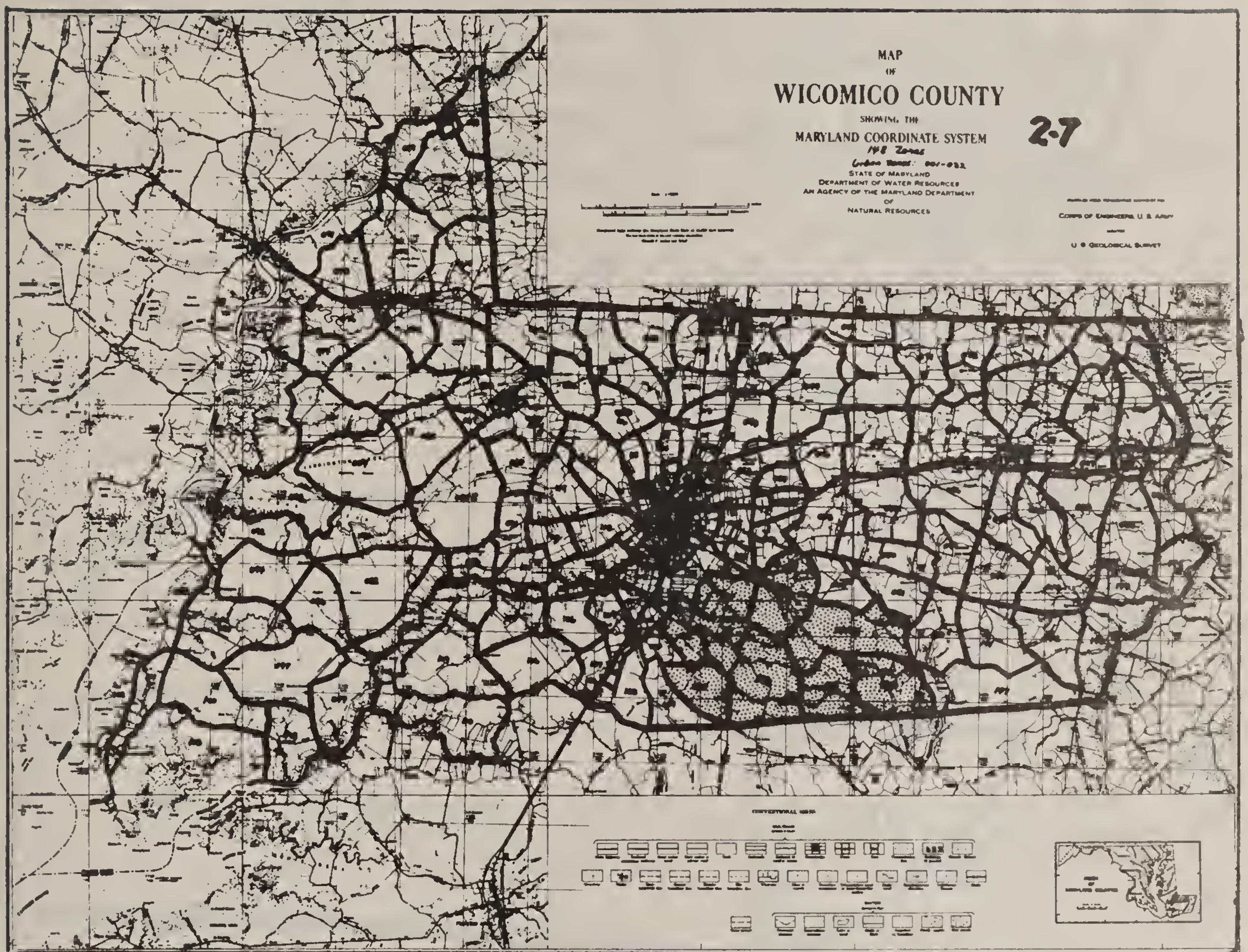

Figure 2--Modified grid cells delineated for Wicomico County, Maryland
(Stipled area is shown in greater detail in Figure 3.)

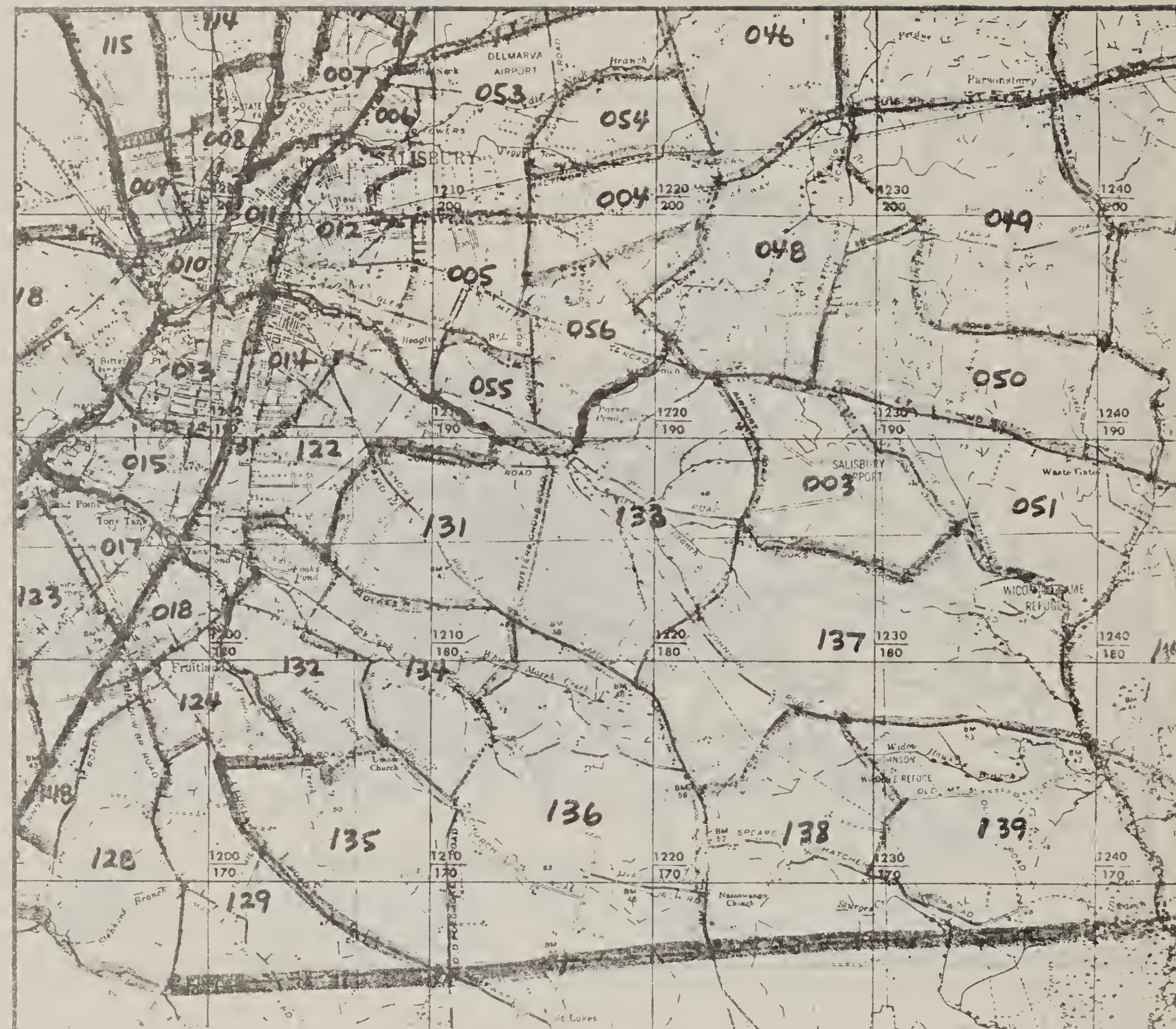

Figure 3--Modified grid cells near Salisbury, Maryland

Table 2 -- Summary of data

Type*	Original form	Coding technique
1. Land use	Maps prepared by state planning programs and USGS CARETS program. Although 1:63360 was the most common scale, 1:24000 and 1:100,000 scale maps were also used. All maps were of 1970 or more recent origin.	Areal estimates of land use categories were obtained from dot counts. As many as 30 categories were possible for an individual state, while 19 aggregate categories were possible for the entire peninsula. USGS Level II and III distinctions were coded where available.
2. Soil groups	Natural Soil Group maps prepared by SCS were prepared at 1:63360 scale.	Areal estimates were prepared (independently of land use) using dot counts. Nineteen categories were possible.
3. County comprehensive plans	Sketch maps.	Primary, secondary and tertiary land uses indicated were recorded in order of dominance.
4. County sewer	Sketch maps.	Presence of existing services and intended extensions noted with a nominal variable to indicate presence or absence.
5. Specialty crops	Sketch maps.	Nominal variables to indicate presence (1) or lack (0) of such activity.
6. Shoreline development	Sample summaries from aerial photographs referenced to selected grid cells.	Various estimates to type and extent of change in designated shoreline cells.
7. Census data	Magnetic tape.	Tables of population and housing data by enumeration districts which were referenced to aggregates of grid cells.
8. Highway networks	Maps of networks and link data on magnetic tape.	Segments of network were joined and estimated times and distances through the network were referenced to grid cells.
9. Agricultural commodity processing sites	Sketch maps and location lists.	Nominal variables to identify facilities with commodities processed.
10. Private outdoor recreation	County maps showing sites of the National Association of Conservation Districts' survey with referenced tables detailing facilities and activities at each site.	Presence of specific facilities and activities was indicated where sites existed.
11. Forest types	Land use maps and U.S. Forest Survey type maps.	Derived by interpretation of land use files.
12. Feedlot operations	Land use maps.	Nominal variable interpreted from land use files.

*Variables 7, 8, 9, and 10 have not been utilized in the work reported here.

Table 3--Summary of major land uses[1/] estimated from the modified grid data files for the Delmarva Peninsula

USGS Level I Code	Land Use Category	Area Acres	Area Sq. Miles	Proportion of Total Area
1	Urban*	131,942	206.2	.037
2	Agriculture (total)	1,572,864	2457.6	.443
	211 Cropland	1,343,027	2098.5	.378
	21 Cropland and pasture	163,507	255.5	.046
	212 Pasture	32,717	51.1	.009
	22 Orchards, nurseries	3,917	6.1	.001
	23 Confined feed operations	24,294	38.0	.007
	25 Misc. Agriculture	5,402	8.4	.002
4	Forest and Brushland*	1,375,667	2149.5	.388
5	Wetlands*	433,562	677.4	.122
6	Ponds and reservoirs	17,894	28.0	.005
7	Beach	12,442	19.4	.004
7	Extraction and transitional land	5,423	8.5	.002
	TOTAL	3,549,794	5546.6	1.001

1/ The USGS general classification scheme for land use categories was used on all base maps, although the detail varied for individual state areas.
* USGS Level III distinctions were available on most maps and were coded for these categories.

Table 4 -- Summary of generalized soil groups[1] estimated from the modified grid files for the Delmarva Peninsula

Symbol	Acres	Square miles	Proportion of total area
A1[2]	375,628	586.9	0.105
A2	29,619	46.3	0.008
B1[2]	988,236	1,544.1	0.277
B2	21,811	34.0	0.006
B3	512	0.8	*
E1	205,722	321.4	0.058
E2	121,856	190.4	0.034
E3	69,606	180.8	0.020
F1	38,835	60.7	0.011
F2	697,216	1,089.4	0.195
F3	461,517	721.1	0.129
G1	384	0.6	*
G2	101,094	158.0	0.028
G3	439,603	686.9	0.123
Ma	9,472	14.8	0.003
Bp or Gp	5,376	8.4	0.002
TOTAL	3,566,487	5,572.9	0.999

1/ These groups, referred to as Natural Soil Groups were originally prepared for the State of Maryland (7) by the Soil Conservation Service (8) and subsequently prepared for Delaware and the Virginia portion of the Delmarva Peninsula.

2/ These soils are represented by small areas in slope categories greater than 10%. The area estimates for these subcategories have been included in the major groups presented in the table.

* Soils which represent 0.1% or less of the total area.

the land use perspective considered. Committee members were encouraged to identify a limited number of criteria for which measures could be derived from previously coded or other readily available data. Participants were then asked to weigh each criterion by distributing 100 points among the criteria. The final distribution of criteria weights was accomplished by repeating a process of weighing, averaging, and comparing until the group reached a consensus (Table 5). This procedure translated generalized subjective concerns into more objective and specific values which could then be further evaluated.

Three priority scores, each ranging from 0 to 100, were computed for each modified grid cell. For any one of the three evaluations performed, a priority score (P_j) was the sum of the products of each criterion score (c_{ij}) and its weights (w_i) as shown below:

$$P_j = \sum_{i=1}^{n} c_{ij} w_i$$

where P_j = score for priority k in modified grid cell j

$\sum w_i = 100$

$0 \leq c_{ij} \leq 1.00$

Urban places, as defined by the census enumeration district maps, were excluded from the priority scoring process and from all subsequent evaluations of the scores.

More important than the actual magnitudes of priority scores are their relative magnitudes. Classifying the range of actual scores for each priority places emphasis on significant differences and variations in this interpretation of the Peninsula's resources. Since the three priority

Table 5--Criteria and weights for evaluation of modified grid cells for three priorities

Agriculture		Forestry		Urban	
Criterion	Weight	Criterion	Weight	Criterion	Weight
1. Proportion of crop-land	48	1. Proportion of woodland	40	1. Proportion of urban land use	36
2. Proportion of soils with slight to moderate limitations for row cropping	36	2. Proportion of soils in differentially weighted productivity classes	30	2. Proportion of area identified for sewer service within 20 years	25
3. Known production of speciality crops yes = 1 no = 0	9	3. Differentially weighted forest types	20	3. Proportion of soils suitable for dwelling construction	23
4. Presence of livestock feeding operations yes = 1 no = 0	7	4. Proportion of soils with limitations for forestry management	10	4. Proportion of area identified for development in county comprehensive plans	11
				5. Areas with shoreline access to water yes = 1 no = 0	5
Total	100		100		100

evaluations were independently conducted, classification also brings the resulting scores into a comparable and relevant basis for the evaluation of conflicts.

Individually, each priority's range of scores was divided to produce five classes. These classes indicate the degree of importance to be attributed to a geographic area for the given perspective being evaluated. This degree of importance can range from "none" to "extreme" as shown in the margins of the diagram in Figure 4.

The process of reviewing the classification of each priority's scores required that these scores be examined in their geographic context. Maps were prepared to illustrate an initial attempt to classify each priority's scores into five groups based on the characteristics of their distributions. These were reviewed and class intervals were adjusted to reflect the judgment of study participants. Although these classes were subjective, the geographic patterns they produce are reasonable given the extensive nature of forestry (Figure 5b) and agriculture (Figure 6a) and the intensive nature of urban uses (Figure 7b). The patterns shown on these maps were used in all subsequent evaluations.

Arbitrarily, five levels of conflict were also defined based on the classes of two or three coincident priorities. The main body of Figure 4 illustrates this conflict level classification in terms of the same scale used to classify two individual priorities. Although the boundaries between conflict classes were arbitrarily set, they define conflict classes symmetrically and logically. The conflict classes are logical in that conflict for an "extreme-extreme" pair is greater than conflict for a

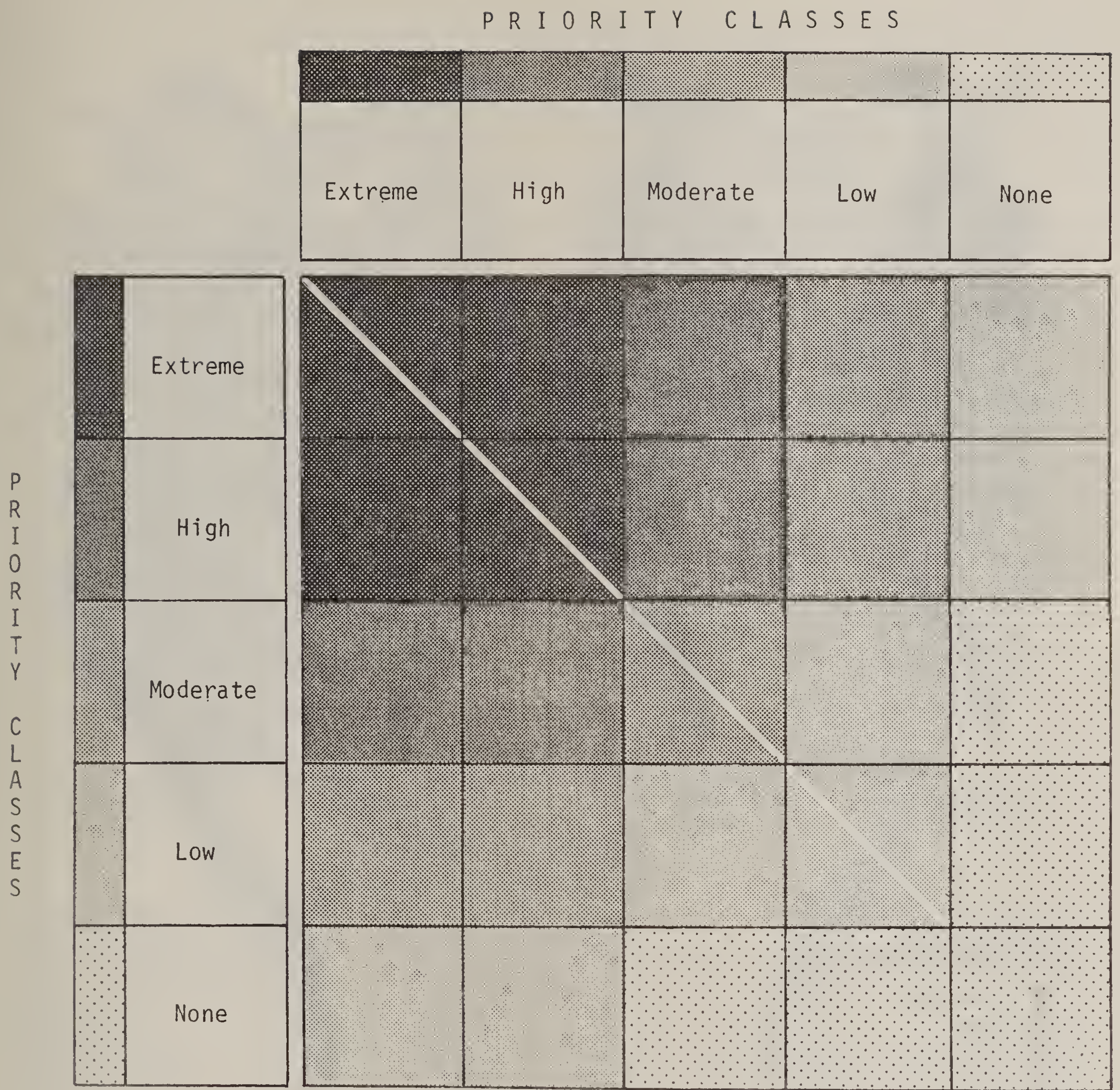

Figure 4--Conflict level derivation for two priorities (Conflict levels are identified by gray tones from the scale used for priority classes. For example, a "High-High" priority pair is in the "Extreme" conflict level and the "Moderate-High" pair is assigned to a "High" conflict level. Since the diagram is symmetrical with respect to the diagonal shown, a "Moderate-High" pair and a "High-Moderate" pair are equivalent in terms of conflict.)

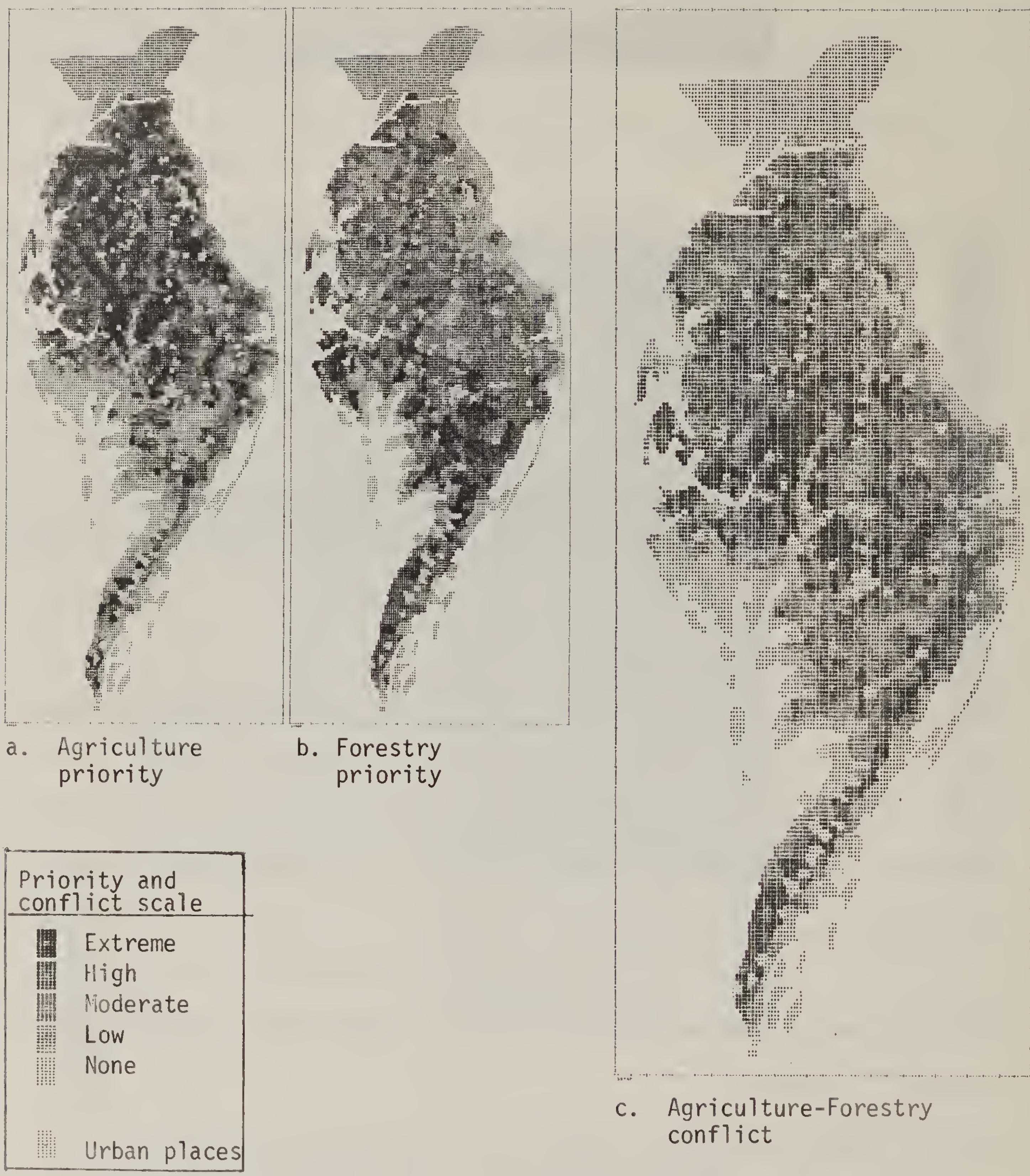

Figure 5--Maps of agriculture and forestry priorities and their conflict on the Delmarva Peninsula

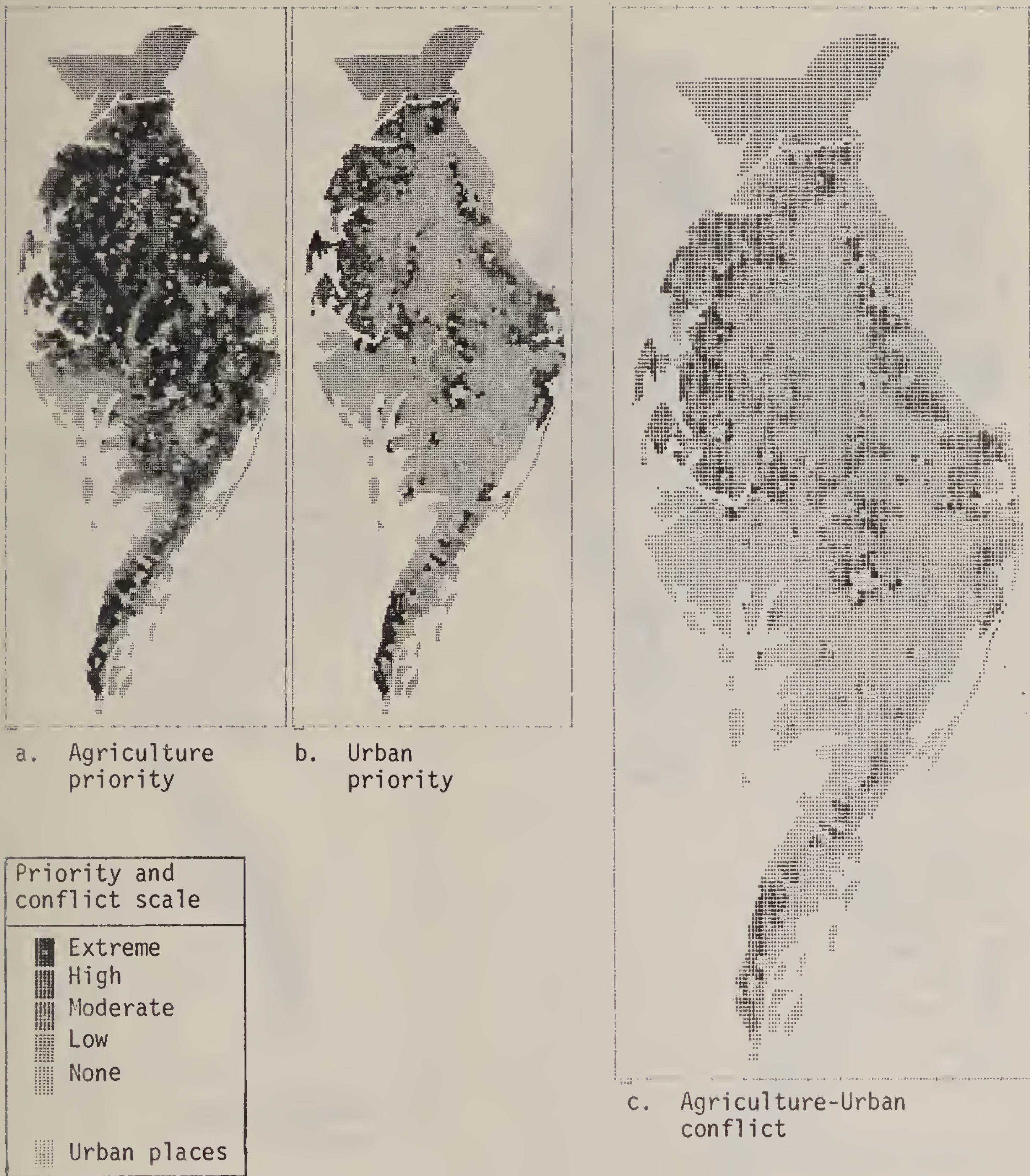

Figure 6--Maps of agriculture and urban priorities and their conflict on the Delmarva Peninsula

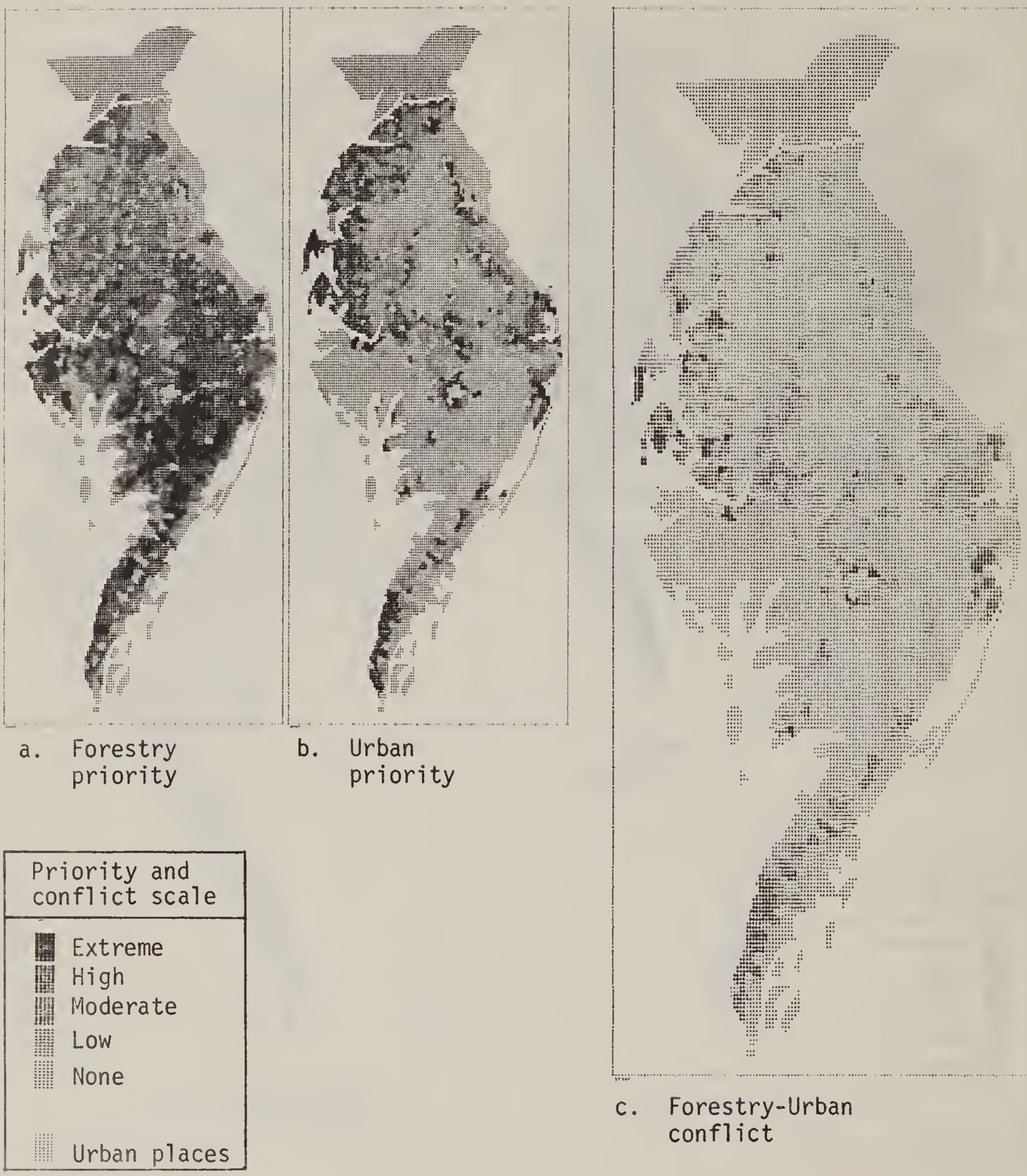

Figure 7--Maps of forestry and urban priorities and their conflict on the Delmarva Peninsula

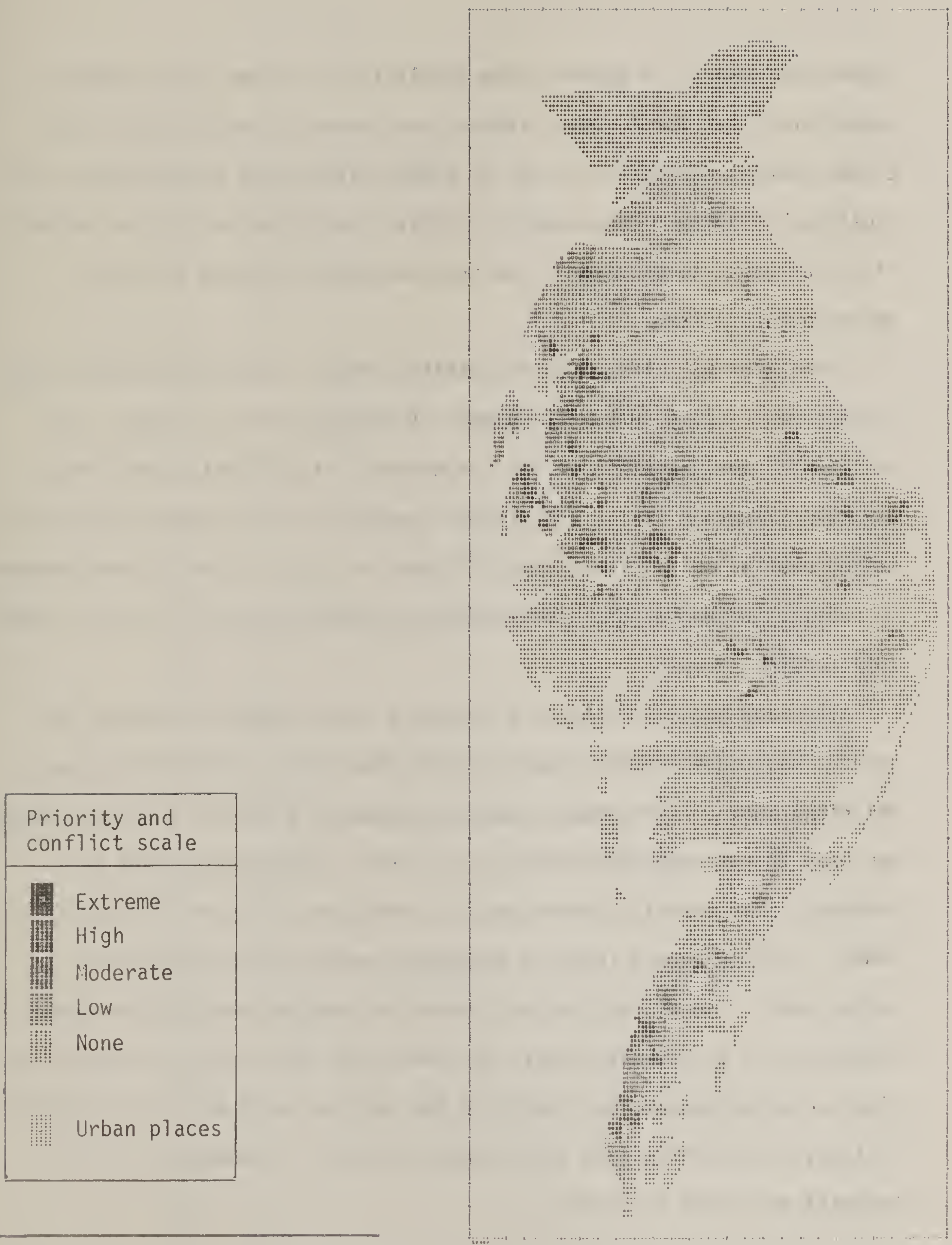

Figure 8--Map of conflicts among forestry, agriculture and urban priorities on the Delmarva Peninsula

"none-none" pair. In general, the conflict level rises in a stepwise manner such that for a given class of one priority, the conflict level either remains constant or rises as higher classes are encountered in the remaining priority. The symmetry of this classification will be evident if one attempts to exchange a row from the classification with its corresponding column.

The three-way classification exhibits these same characteristics but is more restrictive in the assignment of higher conflict classes. To achieve the assignment shown for the two-way classification, the three-way classification of conflict levels requires the third priority to be in its highest priority class. Maps (Figures 5c, 6c, 7c, and 8) were prepared to examine the geographic distributions of these jointly classified scores into conflict levels.

The maps shown in Figures 5 through 8 are intended to display the general geographic patterns which result from the classification process described above. For computer mapping purposes, a centrally located point was used to represent each grid cell's area. The resulting maps are produced by a nearest neighbor mapping procedure of Harvard University's SYMAP. This procedure tends to exaggerate smaller areas relative to larger ones. Therefore, the maps cannot be used to precisely delineate boundaries or to estimate areas, but the actual score and its classification can be determined by consulting the modified grid data base (Table 6). In turn, the modified grid cell number provides a reference to all of the data described in Table 2.

Table 6--Example of priority scores and their classification as priority and conflict levels for a portion of Wicomico County, Maryland (see Figures 2 and 3).

Modified Grid Cell Number	Priority Scoring (Priority Class)						Conflict Level			
	Forestry F		Agriculture A		Urban U		F-A	F-U	A-U	F-A-U
27131	62.6	(4)	72.7	(4)	26.5	(3)	5	4	4	3
27132	52.6	(4)	78.5	(5)	32.0	(3)	5	4	4	4
27133	62.6	(4)	74.5	(4)	20.8	(2)	5	3	3	2
27134	68.5	(5)	61.5	(2)	23.2	(3)	3	4	2	2
27135	76.0	(5)	62.1	(2)	10.1	(1)	3	2	1	1
27136	77.0	(5)	64.0	(2)	7.1	(1)	3	2	1	1
27137	79.2	(5)	59.3	(2)	6.3	(1)	3	2	1	1
27138	82.6	(5)	61.1	(2)	2.6	(1)	3	2	1	1
27139	73.7	(5)	55.7	(2)	6.2	(1)	3	2	1	1

DISCUSSION

Human interaction with the resource base of the Delmarva Peninsula has produced a mosaic of land use activity which reflects important regional variations. Maps of land use priorities show the relatively stronger positions of agriculture on the "upper shore" and forestry on the "lower shore" (Figures 5a and 5b). Higher urban priorities appear as small clusters around larger towns and water related recreation centers and faintly trace out arterial highways connecting major towns (Figure 6b).

The distribution of priorities for agriculture and forestry are strongly controlled by the importance attributed to existing land use and soil suitabilities. Large areas in soils too wet to crop appear in the southern portion of the Peninsula and follow the drainage divide between the Chesapeake and Delaware Bays and are reflected in the map of agricultural priorities (Figure 5a). This pattern is less noticeable on the map of forest priorities (Figure 5b), indicating the common occurrence of woodland on these soils. Although forest is well dispersed over much of the Peninsula, the relatively greater importance attributed loblolly pine (among all forest types) is emphasized on the map of forest priorities.

Less obvious in the individual priorities are the patterns revealed by conflict maps (Figures 5c, 6c, 7c, and 8). Although dispersed from north to south, it is noticeable that larger, more frequent clusters of high to extreme agriculture-forestry conflict occur in a transition area where both agriculture and forestry are important. Conflicts with urban priorities occur primarily in close proximity to expanding towns, recreation centers near the ocean and the entry point of large volumes of traffic

over the Chesapeake Bay Bridge (Figures 6c and 7c).

Closer examination of the agriculture-forestry conflict areas reveals a number of very prominent clusters. These would be expected in areas where soils of good to moderate suitability for both forestry and agriculture support some acreage of both land uses. Where these areas are representative of the best agricultural soils in these states, smaller proportions of forested land were sufficient to signal a conflict with the dominant agriculture use. Such woodland, particularly where it occupies soils especially suitable for agriculture, is subject to possible clearing as farm sizes increase and crop production becomes more intensively managed.

Many of the forestry-agriculture conflict clusters also occur where soils are either excessively or poorly drained. Some large clusters of the highest level conflict in the transition area at the center of the Peninsula occur largely in areas where soils are excessively drained. Other smaller pockets are more clearly associated with poor drainage where wetness is a limitation to cropping. The impact of human manipulation of water regimes through irrigation or through drainage or the natural deterioration of drainage would have greater implications for the location, magnitude, and direction of shifts in land use between crop and forest uses in these localities. Human modification and the natural deterioration of drainage have historically been the more important of these two factors influencing the equilibrium in land use from place to place. To the extent that improvements in drainage are contemplated or that deterioration of drainage is expected in any given watershed, an awareness of the potential competition between crop and forest uses might anticipate

otherwise unexpected changes and unnoticed opportunities to improve both agricultural and forest resources.

An additional map of environmental priorities would also be useful in the effort to evaluate the impact of changing conditions in each of the Peninsula's watersheds. This map could include criteria based on general wildlife habitat evaluations, the location of known endangered species habitats, and other unique biological amenities. If such a map were developed within the framework used to evaluate the priorities presented in this paper, additional conflicts would be identified.